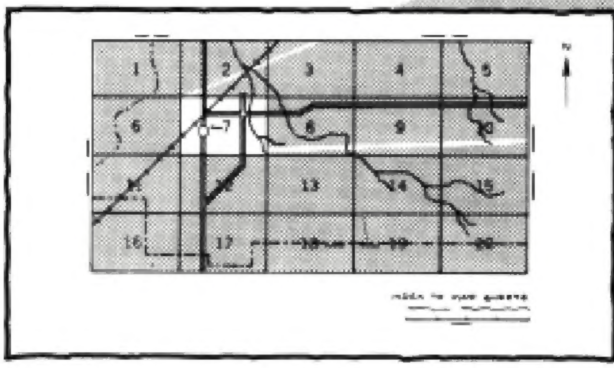
Soil Survey of

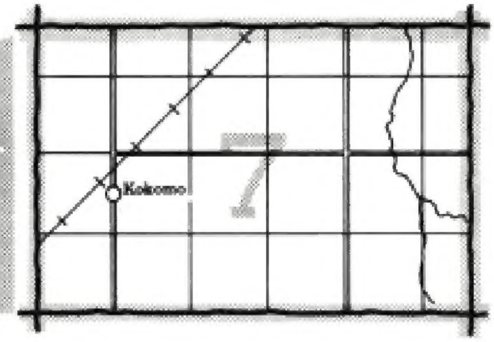
LAGRANGE COUNTY, INDIANA

United States Department of Agriculture
Soil Conservation Service
in cooperation with
Purdue University Agricultural Experiment Station

HOW TO USE

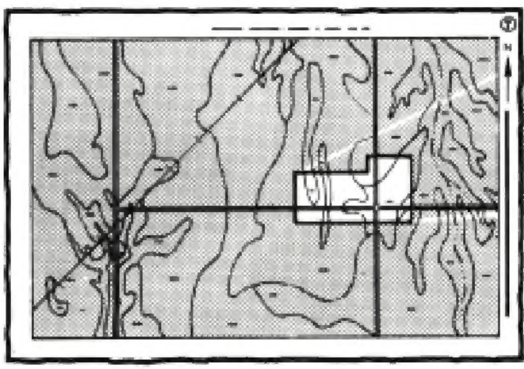
1. Locate your area of interest on the "Index to Map Sheets"

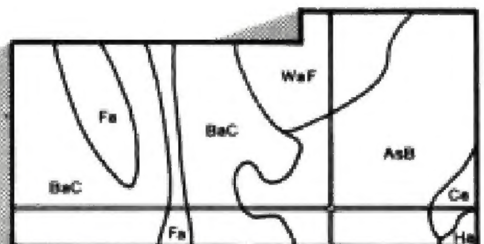




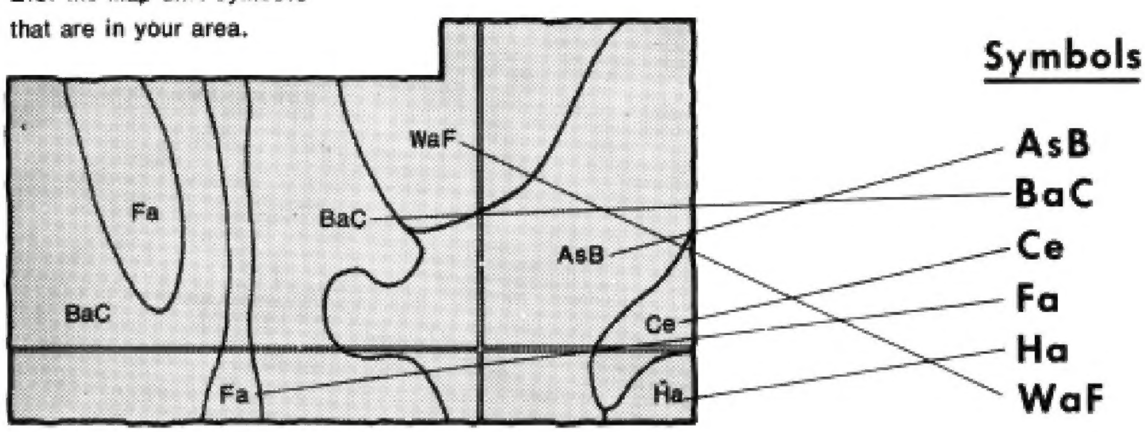
2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.



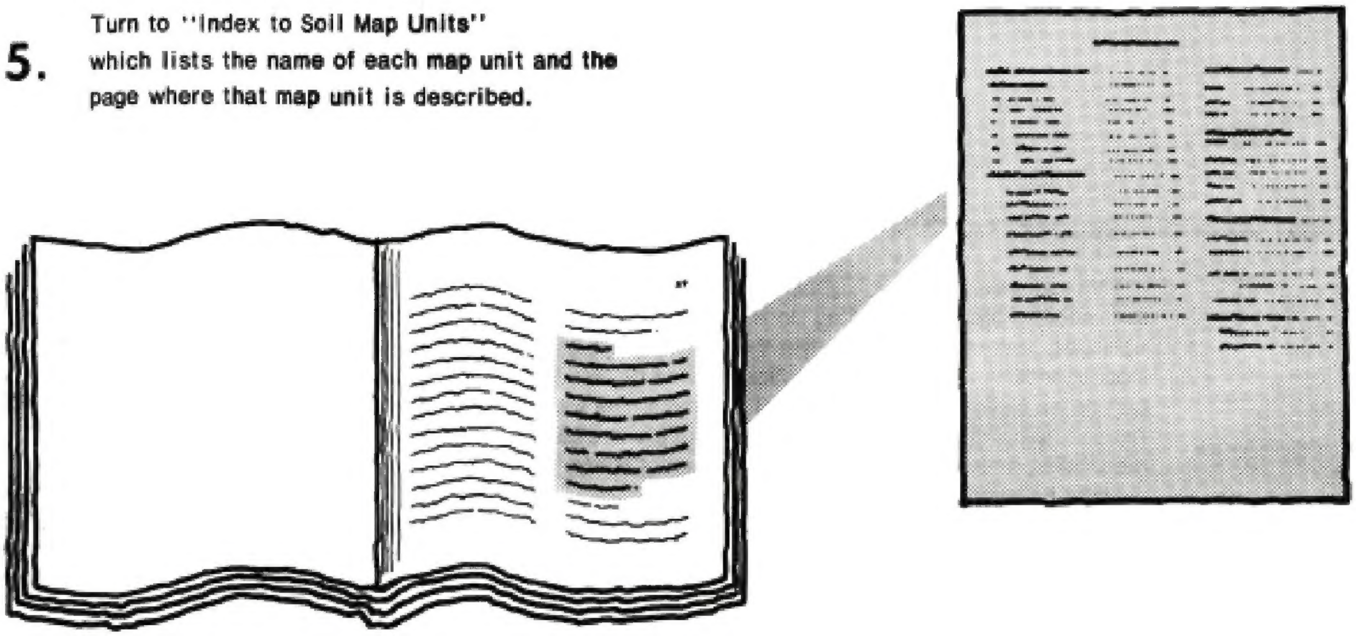


4. List the map unit symbols that are in your area.

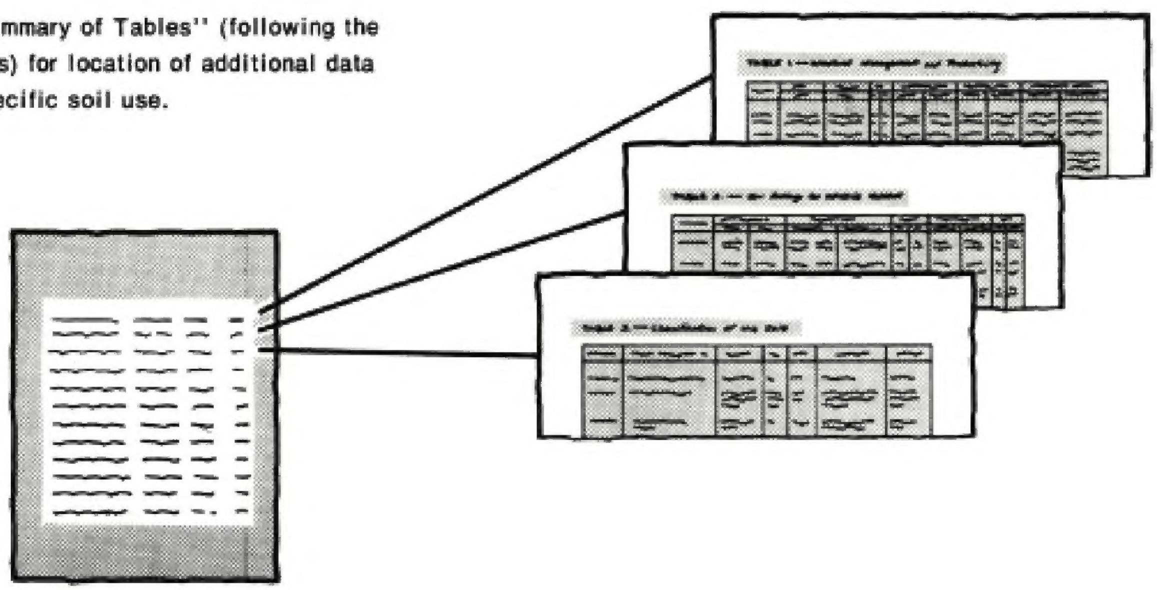


THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to specialists in wildlife management, waste disposal, or pollution control.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was performed in the period 1971-77. Soil names and descriptions were approved in 1976. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1976. This survey was made cooperatively by the Soil Conservation Service and Purdue University Agricultural Experiment Station. It is part of the technical assistance furnished to the Lagrange County Soil and Water Conservation District.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

Cover: Corn in a no-tillage system in areas of Wawasee and Metea soils.

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Issued—April 1980

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Foreword

This soil survey contains information that can be used in land-planning programs in Lagrange County, Indiana. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, ranchers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

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SOIL SURVEY OF LAGRANGE COUNTY, INDIANA

By John H. Hillis, Soil Conservation Service

Fieldwork by John H. Hillis, Frank R. Kirschner, Paul McCarter, Jr., and Hezekiah Benton, Jr., Soil Conversation Service

United States Department of Agriculture, Soil Conservation Service, in cooperation with Purdue University Agricultural Experiment Station

Lagrange County is in the northeastern part of Indiana (fig. 1). It has a land area of 379 square miles, or 242 560 acres. The county is about 16 miles from north to south and 24 miles from east to west. Lagrange, the largest city in the county, is the county seat. The population of Lagrange County is about 23,000. Businesses within the county employ nearly the entire work force. There are several trailer and trailer related factories, recreation vehicle factories, and tool factories. Much of the work force is engaged in farming and farm industry.

About 77 percent of the county is actively farmed. Corn, soybeans, wheat, and forage are the main crops. Small, productive truck farms and orchards are in the county. The acreage in farms is slightly decreasing because of urban development.

Figure 1.—Location of Lagrange County in Indiana.

General nature of the county

Additional information about the soil survey area is given in this section. It will be most useful to persons not familiar with Lagrange County. It describes the history and settlement, relief, water, climate, transportation facilities, school facilities, and trends in population and land use.

History and settlement

Lagrange County was organized on May 14, 1832. It contains 11 townships, three of which border on the State of Michigan.

The first settlement in the county was near Howe where the Pottawatomi Indians had established a village on the Pigeon River. The settlement was first called Mongonquinong, supposedly named after an Indian princess. The name was changed to Lima and, later, to Howe. Howe Military Academy, an Episcopal school for boys, was founded in 1884.

The first county seat was at Lima; however by an act of the legislature, the county seat was moved to Lagrange because it was more centrally located. In 1844 a new courthouse was built, and this serves the county today.

The first school of higher education in northern Indiana was the Lagrange Collegiate Institute at Ontario. This school opened in 1837. It was destroyed by a tornado in 1965.

Greenfield Township was settled by English immigrants. The first school building in the township was built in 1830 from logs. The village of Brighton was platted in 1836, and the Greenfield Mills, nearby, was built in 1834 and rebuilt in 1846.

Eden Township was named for its fertile soil. Clearspring and Eden Townships were originally one. The town of Topeka is in both townships. Shipshewana, in Newbury Township, was founded in 1889 and named for Chief Shipshewana. Ancient moundbuilders once inhabited the area of Shipshewana.

The Pisgah "range" to the south provides a beautiful scenic drive for sightseers. The village of Plato at the junction of old Indian trails offers an opportunity to see a rare geological formation called "The Knobs." This high ridge continues one-half mile north of U. S. Highway 20.

Lagrange County has held an agricultural fair annually since 1852. No other county in the State has such a long history of agricultural fairs.

The Pigeon River Fish and Wildlife Area occupies about 12,000 acres of the county. It is along a meandering 16-mile stretch of the beautiful Pigeon River about 8 miles northeast of the city of Lagrange. This area is dotted with many small marshes and medium size water impoundments. It offers hunting, fishing, and outdoor recreation to the public.

Thousands of trout are stocked annually in the cold lakes and main streams of Lagrange County. The carryover of stocked fish from year to year is substantial, making trout fishing a favorite sport in Lagrange County.

Relief

The terrain of this county varies widely. Numerous lakes, bogs, and marshes dot the countryside. The many creeks, streams, and drainageways mainly drain into the Pigeon, Fawn, and Little Elkhart Rivers. Moderate relief and a few abrupt changes characterize the physiography of the area. Elevation ranges from about 800 to 1,100 feet above sea level.

The highest point in Lagrange County is in Springfield Township section 35, near Mount Pisgah. It is 1,080 feet above sea level. The lowest point in the county is Fish Lake in Van Buren Township. It is 814 feet above sea level.

Water

Ground water is the major source of water in Lagrange County. This supply is stored in glacial sand and gravel deposits overlying Mississippian age bedrock formations.

Surface water supplies stored in the seventy one natural lakes of Lagrange County constitute another important source of water. They provide an adequate water base for recreation, wildlife, agriculture, and industry. The lakes have a total surface area of about 4,370 acres. In addition to the natural lakes, the county has 28 manmade lakes of 1 acre or more.

The overall water supplies in Lagrange County are expected to be adequate for future municipal, industrial, and agricultural needs.

Climate

Prepared by the National Climatic Center, Asheville, North Carolina.

Lagrange County is cold in winter and is warm or occasionally hot in summer. Precipitation is well distributed throughout the year with a moderate peak in summer. It is adequate for most crops on most soils. The precipitation in winter is mainly snow, which occurs at times in blizzard conditions.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Goshen, Indiana in the period 1951 to 1974. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 27 degrees F, and the average daily minimum temperature is 20 degrees. The lowest temperature on record, which occurred at Goshen on February 26, 1963, is -20 degrees. In summer the average temperature is 71 degrees, and the average daily maximum temperature is 82 degrees. The highest recorded temperature, which occurred on June 28, 1971, is 101 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (40 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is 20 inches. Of this, 60 percent usually falls in April through September, which includes the growing season for most crops. In 2 years out of 10, the rainfall in April through September is less than 17 inches. The heaviest 1-day rainfall during the period of record was 3.22 inches at Goshen on June 20, 1954. Thunderstorms occur on about 45 days each year, and most occur in summer.

Average seasonal snowfall is 33 inches. The greatest snow depth at any one time during the period of record was 13 inches. On an average of 25 days, at least 1 inch of snow is on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 65 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 70 percent of the time possible in summer and 40 percent in winter. The prevailing wind is from the south-southwest. Average windspeed is highest, 12 miles per hour, in March.

Severe thunderstorms occur occasionally, and tornadoes are rare. Both are generally local and of short duration and cause damage in a variable pattern.

Transportation facilities

Indiana Toll Road crosses the northern part of Lagrange County in an east-west direction. At Lagrange, U. S. Highway 20 runs east and west across the middle of the county, and State Highway 9 runs north and south. About 50 miles of state highways and 750 miles of primary and secondary collector roads provide transportation within the county. Many of these roads are gravel.

Two small airports serve the county, and there is very little railroad service.

School facilities

Public schools are within easy access from any part of the county. There are three public high schools. The high schools are on the eastern side of the county, in the center, and on the western side. Numerous parochial elementary schools are available.

Trends in population and land use

Population of Lagrange County is about 23,000, and the population density is 54 people per square mile. The population increased from 17,380 to 20,900, or 20.2 percent, between 1960 and 1970. From 1950 to 1960 the population increased from 15,347 to 17,380, reflecting an increase of 13 percent. Population estimates project an increase of 23.9 percent from 1970 to 1980, or approximately 26,000. This indicates that Lagrange County continues to be a rural county, having only a small change in land use.

How this survey was made

Soil scientists made this survey to learn what soils are in the survey area, where they are, and how they can be used. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; and the kinds of rock. They dug many holes to study soil profiles. A profile is the sequence of natural layers, or horizons, in a soil. It extends from the surface down into the parent material, which has been changed very little by leaching or by plant roots.

The soil scientists recorded the characteristics of the profiles they studied and compared those profiles with others in nearby counties and in more distant places. They classified and named the soils according to nationwide uniform procedures. They drew the boundaries of the soils on aerial photographs. These photographs show trees, buildings, fields, roads, and other details that help in drawing boundaries accurately. The soil maps at the back of this publication were prepared from aerial photographs.

The areas shown on a soil map are called map units. Most map units are made up of one kind of soil. Some are made up of two or more kinds. The map units in this survey area are described under "General soil map for broad land use planning" and "Soil maps for detailed planning."

While a soil survey is in progress, samples of some soils are taken for laboratory measurements and for engineering tests. All soils are field tested to determine their characteristics. Interpretations of those characteristics may be modified during the survey. Data are assembled from other sources, such as test results, records, field experience, and state and local specialists. For example, data on crop yields under defined management are assembled from farm records and from field or plot experiments on the same kinds of soil.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it can be used by farmers, woodland managers, engineers, planners, developers and builders, home buyers, and others.

General soil map for broad land use planning

The general soil map at the back of this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each map unit on the general soil map is a unique natural landscape. Typically, a map unit consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one unit can occur in other units but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one map unit differ from place to place in slope, depth, drainage, and other characteristics that affect management.

The soils in the survey area vary widely in their suitability for major land uses. Table 4 shows the extent of the map units shown on the general soil map. It lists the suitability of each, in relation to that of the other map units, for specified land uses and shows soil properties that limit use.

Each map unit is rated for *cultivated crops, specialty crops, woodland, urban uses,* and *recreation areas.* Cultivated crops are those grown extensively in the survey area. Specialty crops are the vegetables and fruits that generally require intensive management. Woodland refers to areas of native or introduced trees. Urban uses include residential, commercial, and industrial developments. Intensive recreation areas are campsites, picnic areas, ballfields, and other areas that are subject to heavy foot traffic. Extensive recreation areas are those used for nature study and as wilderness.

The names, descriptions, and delineations of soils on the general soil map of this county do not always agree or join fully with those of adjoining counties published at an earlier date. This difference is because of changes in concepts of soil series in the application of the soil classification system. Other differences are brought about by a different predominance of soils in map units made up by two or three series. Other differences are caused by the range in slope allowed within the map unit of adjoining surveys. In this county or in adjacent counties a map unit is sometimes too small to be delineated.

Descriptions and potential of map units

1. Wawasee-Hillsdale-Conover

Nearly level to strongly sloping, well drained and somewhat poorly drained, moderately coarse textured and medium textured soils on till plains and moraines

This map unit occupies about 34 percent of the county. About 30 percent of this unit is Wawasee soils, 17 percent is Hillsdale soils, and 14 percent is Conover soils. The remaining 39 percent is soils of minor extent.

The well drained Wawasee soils are on knobs and breaks between drainageways. The well drained Hillsdale soils are on ridges between drainageways and on level till plains. The somewhat poorly drained Conover soils are on broad flats or along drainageways.

Of minor extent in this map unit are the Boyer, Oshtemo, Chelsea, Metea, and Martinsville soils on positions similar to those of the major soils. The Whitaker soils are on slightly lower positions in the landscape; the Rensselaer soils are in depressions and drainageways, and the Houghton soils are in the deeper depressions and low-lying pockets.

Areas of this map unit are used mainly for cultivated crops and for pasture. A few areas are in woodland.

The soils in this unit are well suited to cultivated crops. Erosion is a major hazard in the use and management of the sloping, well drained soils. Low available water capacity is a limitation on the Hillsdale soils. Wetness is a limitation on the Conover soils. These soils are well suited to residential uses and to other urban uses.

2. Boyer-Oshtemo

Nearly level to moderately steep, well drained, coarse textured soils on outwash plains, valley trains, moraines, and kames

This map unit occupies about 30 percent of the county. About 39 percent of this unit is Boyer soils and 33 percent is Oshtemo soils. The remaining 28 percent is soils of minor extent.

The Boyer and Oshtemo soils are on approximately the same positions in the landscape (fig. 2). The Boyer soils are underlain with sand and gravel at a depth of 22 to 40 inches, and the Oshtemo soils have sand and gravel at a depth of 40 to 66 inches.

Of minor extent in this map unit are the Adrian and Houghton soils in the deeper depressions and low-lying pockets; the Brady, Homer, and Bronson soils on slightly lower positions in the landscape; the Gilford and Sebewa soils in depressions on the outwash flats and along large drainageways; and the Hillsdale and Chelsea soils on moraines.

Areas of this map unit are used mainly for cultivated crops or pasture. A few areas are in woodland.

The soils in this unit are suited to cultivated crops. Low available water capacity is the main limitation, and erosion is a hazard in the more sloping areas. Irrigation in the less sloping areas of these soils helps to increase production of crops. These soils are well suited to residential uses and other urban uses. Seepage and the possible contamination of ground water supplies are hazards to urban development.

3. Sebewa-Gilford-Homer

Nearly level, very poorly drained and somewhat poorly drained, medium textured and moderately coarse textured soils on outwash plains and valley trains

This map unit occupies about 10 percent of the county. About 44 percent of this unit is Sebewa soils, 17 percent is Gilford soils, and 15 percent is Homer soils. The remaining 24 percent is soils of minor extent.

The very poorly drained Sebewa soils are in broad, level and depressional areas. The very poorly drained Gilford soils are intermingled with the Sebewa soils on the broad, level and depressional outwash plains. The somewhat poorly drained Homer soils are on rises and knolls on broad outwash plains.

Of minor extent in this map unit are the Adrian soils in deeper depressions and low-lying pockets, the Brady and Bronson soils on slightly higher positions in the landscape, and the Rensselaer soils on terraces or outwash plains.

Areas of this map unit are used mainly for cultivated crops. Most of the acreage has been drained. A few swampy, undrained areas are in woodland or pastureland.

If adequately drained, the soils in this map unit are well suited to cultivated crops. Wetness is the main limi-

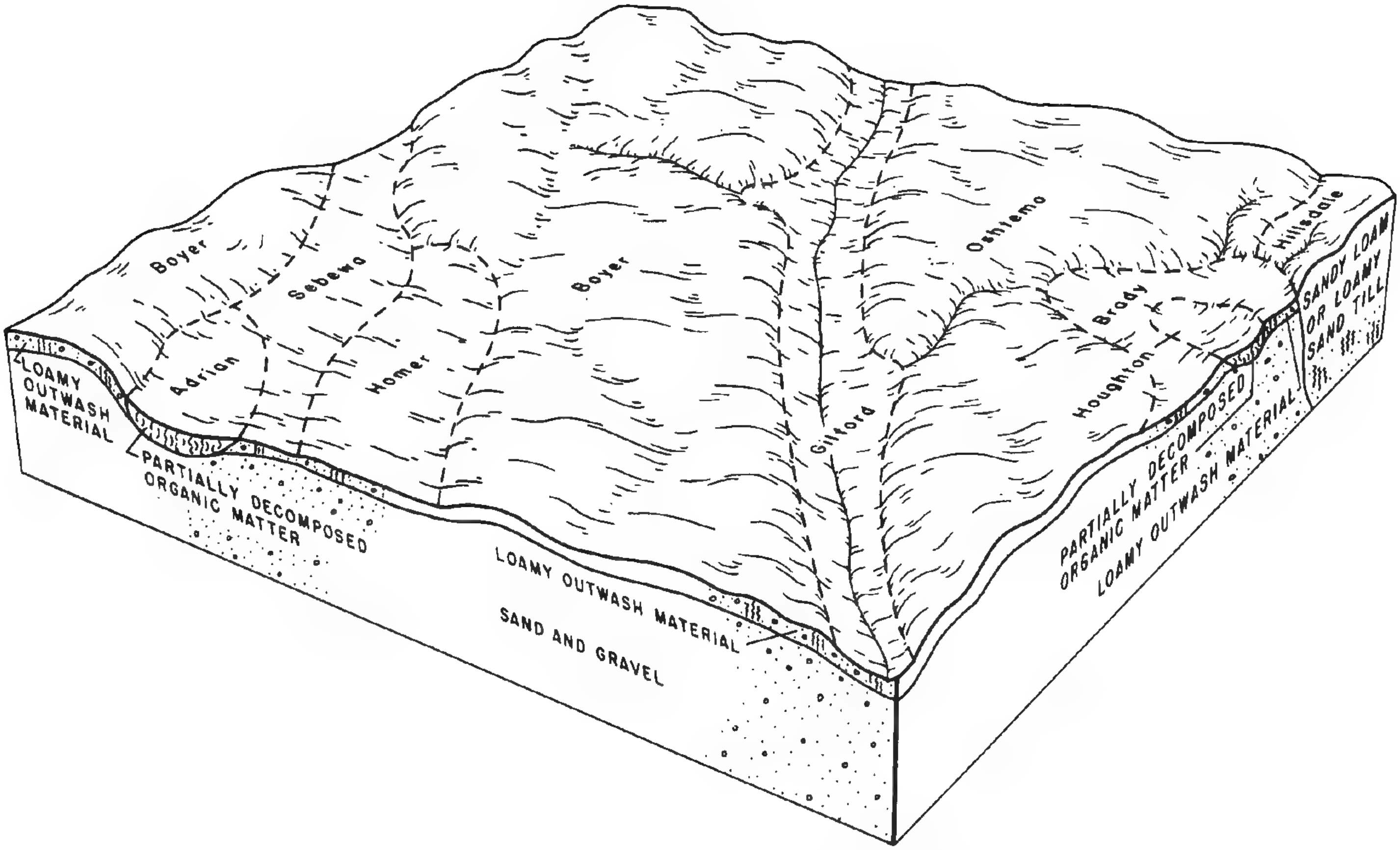

Figure 2.—General pattern of soils and underlying material in the Boyer-Oshtemo map unit.

tation for farming and for most other uses. Ponding is common in undrained areas during winter and spring. These soils are poorly suited to residential and other urban uses because of wetness. This limitation is severe, and is difficult to overcome. Adequate drainage must be the first consideration for urban development.

4. Plainfield-Gilford

Nearly level to moderatley sloping, excessively drained and very poorly drained, coarse textured and moderately coarse textured soils on outwash plains, knolls, and eolian dunes

This map unit occupies about 8 percent of the county. About 60 percent of this unit is Plainfield soils and 11 percent is Gilford soils. The remaining 29 percent is soils of minor extent.

The excessively drained Plainfield soils are in broad, nearly level areas and on side slopes around depressions along drainageways. The very poorly drained Gilford soils are on flats around muck areas and along streambeds.

Of minor extent in this map unit are the Adrian and Houghton soils in the deeper depressions and low-lying pockets, the Boyer and Oshtemo soils generally on the outer edges of this map unit, and the Chelsea soils generally intermingled with the Plainfield soils. Also of minor extent are the Brems and Granby soils in lower lying flats and depressional areas that contain more sand throughout than the Gilford soils.

A large part of this map unit is used for wildlife habitat and is in the Pigeon River Fish and Wildlife Area. Some areas are used for cultivated crops and for pasture. A few areas are in woodland.

The soils in this unit are poorly suited to cultivated crops. Low available water capacity is the main limitation on the Plainfield soils and wetness is the main limitation on the Gilford soils. Irrigation in less sloping areas of the Plainfield soils helps to increase the production of crops. In most areas of this unit, these soils are well suited to residential and other urban uses.

5. Shipshe-Parr

Nearly level to moderately sloping, well drained, moderately coarse textured and medium textured soils on outwash plains and till plains

This map unit occupies about 7 percent of the county. About 75 percent of this unit is Shipshe soils and 14 percent is Parr soils. The remaining 11 percent is soils of minor extent.

The well drained Shipshe soils are on broad flats that are intermingled with more sloping areas. The Shipshe soils are underlain with sand and gravel at a depth of 24 to 40 inches. The well drained Parr soils are on broad flats and formed in glacial till. Both of these soils developed under prairie vegetation.

Of minor extent in this map unit are the Boyer and Oshtemo soils, which generally border areas of Shipshe soils, and the Wawasee soils, which border areas of Parr soils.

Areas of this map unit are used mainly for cultivated crops and for pasture.

The soils in this unit are suited to cultivated crops. Low available water capacity is a limitation in most areas of this unit, and erosion is a hazard on the more sloping areas. Irrigation helps to increase the production of crops. These soils are well suited to residential and other urban uses.

6. Houghton-Adrian

Nearly level, very poorly drained muck soils in depressional areas on outwash plains, till plains, and moraines

This map unit occupies about 6 percent of the county. About 51 percent of this unit is Houghton soils and 18 percent is Adrian soils. The remaining 31 percent is soils of minor extent.

The very poorly drained Houghton and Adrian soils are in bogs and other depressional areas. The Houghton soils have an organic layer more than 51 inches thick. The Adrian soils have an organic layer 16 to 50 inches thick and are underlain with sand and gravel.

Of minor extent in this map unit are the Edwards and Martisco soils that are underlain with marl, the Palms soils that are underlain with loamy material, and the Wallkill soils that have 16 to 40 inches of alluvial material on the surface. Also of minor extent are the Rensselaer, Gilford, and Sebewa soils that generally surround areas of muck.

Most areas of this map unit that are not drained are idle and have vegetation of water-tolerant trees, shrubs, sedges, and grasses. Drained areas are mostly used for cropland. Corn and soybeans are the main crops. Special crops are mint, blueberries, sweet corn, potatoes, and onions.

The soils in this unit are suited to cultivated crops and poorly suited to residential and other uses.

7. Blount-Pewamo

Nearly level and gently sloping, somewhat poorly drained and very poorly drained, medium textured and moderately fine textured soils on till plains

This map unit occupies about 3 percent of the county. About 45 percent of this unit is Blount soils and 16 percent is Pewamo soils. The remaining 39 percent is soils of minor extent.

The somewhat poorly drained Blount soils are on the higher lying, broad flats and slight rises in the landscape. The very poorly drained Pewamo soils are in the more depressional areas, in swales, and along poorly defined drainageways.

Of minor extent in this map unit are the Haskins soils intermingled on the landscape with the Blount soils, the Nappanee soils on the slightly lower lying positions, the Morley and Rawson soils on the higher lying positions, and the Houghton soils in the deeper depressions and low-lying pockets. In the southwest corner of the county the Blount-Pewamo unit contains about 1,000 acres of Nappanee soils.

Areas of this map unit are used mainly for cultivated crops and for pasture. A few areas are in woodland. Most of the acreage has been drained.

If adequately drained, the soils in this map unit are well suited to cultivated crops. Wetness is the main limitation for farming and for most other uses. Ponding or flooding is common in winter and spring, especially in undrained areas. These soils are poorly suited to urban uses, because of the wetness. This limitation is severe and is very difficult to overcome. Adequate drainage must be the first consideration for urban development.

8. Rawson-Morley

Gently sloping to strongly sloping, well drained and moderately well drained, medium textured and moderately coarse textured soils on till plains and moraines

This map unit occupies about 2 percent of the county. About 18 percent of this unit is Rawson soils and 15 percent is Morley soils. The remaining 67 percent is soils of minor extent.

These moderately well drained and well drained Rawson and Morley soils are generally on the same positions in the landscape, mainly on knobs and breaks between drainageways.

Of minor extent in this map unit are the Conover, Blount, and Haskins soils on the somewhat lower positions in the landscape; the Houghton soils in the deeper depressions and low-lying pockets; and the Pewamo and Rensselaer soils in depressions and drainageways. Also of minor extent are the Metea, Wawasee, and Chelsea soils on the outer edges of the map unit intermingled with the Rawson and Morley soils.

Areas of this map unit are used mainly for cultivated crops and for pasture. A few areas are in woodland.

The soils in this map unit are well suited to cultivated crops. The hazard of erosion is a major concern in use

and management. Wetness is a limitation to some of the soils of minor extent. Except for the more sloping soils, these soils are fairly well suited to residential and other urban uses.

Broad land use considerations

Deciding which land in the survey area should be used for urban development is important. Each year, a small amount of land is developed for urban uses in Lagrange, Shipshewanna, Topeka, and other towns in the county. An estimated 4,300 acres, or nearly 2 percent of the survey area, is urban or built-up land. The general soil map is helpful for planning the general outline of urban areas; it cannot be used for the selection of sites for specific urban structures. Generally, in the survey area, the soils are well suited to cultivated crops and to urban development.

Areas in which the soils are so unfavorable that urban development is prohibitive are not extensive. However, large areas of the Sebewa-Gilford-Homer and the Blount-Pewamo map units are very poorly drained or somewhat poorly drained. In these areas wetness, flooding, and ponding are severe limitations. Urban development is very costly on the soft, wet organic soils that are in the Houghton-Adrian map unit and in minor areas in several other map units. Also, urban development is very costly on the steeper soils in the Boyer-Oshtemo map unit.

The clayey soils of the Rawson-Morley map unit are poorly suited for urban development because of high shrink-swell potential.

The Wawasee and Hillsdale soils in the Wawasee-Hillsdale-Conover map unit are well suited to urban development, and the Wawasee soils are excellent farmland. The Conover soils in this map unit have a drainage limitation for both urban and farm uses.

The Parr soils in the Shipshe-Parr map unit are some of the best soils in the county for farming. These soils are near Topeka and are being built on as the town expands. They have only a slight or moderate limitation for building purposes. The Shipshe soils of this map unit need irrigation for cropping, but make good building sites.

Soils in the Sebewa-Gilford-Homer map unit are well suited to farming, but are poorly suited to nonfarm uses. Wetness is a severe limitation to the nonfarm uses of these soils, but proper subsurface and surface drainage helps overcome this limitation.

Vegetables and other specialty crops are suited to the Plainfield soils of the Plainfield-Gilford map unit. The Plainfield soils are excessively drained and warm up earlier in spring than finer textured, wetter soils. Proper drainage needs to be installed in the Gilford soils for optimum production. Also suited to vegetables and specialty crops are the organic soils of the Houghton-Adrian map unit which are scattered throughout the county.

Most soils in the county are well suited to woodland. Commercially valuable trees are less common and generally do not grow as rapidly on the wetter soils of the Sebewa-Gilford-Homer and Blount-Pewamo map units as they do on the soils in the other map units. Many trees are grown commercially for Christmas trees on the Plainfield soils of the Plainfield-Gilford map unit.

The soils in the Wawasee-Hillsdale-Conover map unit are well suited to parks and extensive recreation areas. Hardwood forests enhance the beauty of these soils. Undrained areas of soils in the Plainfield-Gilford map unit are suitable for nature study, particularly those in the Pigeon River Fish and Wildlife Area. All of the soils in these map units provide habitat for many important species of wildlife.

Soil maps for detailed planning

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and management of the soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil, a brief description of the soil profile, and a listing of the principal hazards and limitations to be considered in planning management.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the underlying material, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Wawasee fine sandy loam, 2 to 6 percent slopes, is one of several phases in the Wawasee series.

Some map units are made up of two or more major soils. These map units are called soil complexes.

A *soil complex* consists of two or more soils in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Oshtemo-Hillsdale-Chelsea complex, 3 to 6 percent slopes, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some

of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Pits, gravel, is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

Table 5 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

Ad—Adrian muck. This soil is nearly level and very poorly drained. It is on lower elevations on outwash plains and uplands along drainageways and in the deeper part of depressions. Surface runoff from adjacent higher lying areas frequently ponds on this soil. Areas are generally small and irregular in shape. They range from 2 to 80 acres.

Typically, the surface layer is black muck about 14 inches thick. The next 11 inches is black muck. The substratum to a depth of 60 inches is loose, gray sand. In some small areas loamy material underlies the muck, or less than 15 inches of muck overlies the sand and gravel. In some areas the loamy material is 1 to 2 feet thick, and beneath the loamy material is loose sand and gravel.

Permeability is moderately slow to moderately rapid in the muck layer and rapid in the substratum. Available water capacity is moderate or high, and organic matter content is very high. Surface runoff is very slow. The seasonal high water table is at the surface or water is ponded on this soil.

Very few areas of this soil are farmed. Many areas are used for wetland wildlife habitat, and some are used for permanent pasture.

This soil is generally not suitable for crops because of wetness, but some areas are suited to reed canarygrass. The excessive water is very difficult to remove because of the high water level in the adjacent lakes. Open ditches, tile drains, surface drains, pumps, or a combination of these measures are feasible in some areas.

This soil is poorly suited to trees; however, water-tolerant hardwoods commonly ring the perimeter of this soil. The natural permanent vegetation provides good habitat for wildlife. Seed-bearing woody shrubs provide an abundance of protective cover and food for wildlife. The natural vegetation generally includes water-tolerant grasses, sedges, reeds, and woody brush.

The limitation is severe on this soil for building sites because of the ponding. Most areas are difficult to drain because they are commonly in the lowest part of the landscape. In some areas, pumping is the only suitable means of draining. The muck is very unstable for building purposes, and piling is necessary in places.

The limitation is severe for local roads and streets because of the ponding, high potential frost action, and low strength. Excavating the muck to an underlying mineral soil and elevating the roadway, in combination with a good drainage system along the roadway, help to overcome these limitations.

The limitation is severe for septic tank absorption fields because of the ponding. All sanitary facilities should be connected to commercial sewers and treatment facilities.

This soil is in capability subclass Vw and woodland suitability subclass 4w.

Am—Adrian muck, drained. This soil is nearly level and very poorly drained. It is on the lower elevations of outwash plains and uplands along drainageways and in the deeper part of depressions. Surface runoff from adjacent higher lying areas frequently ponds on this soil. Areas are generally small and irregular in shape. They are dominantly about 20 acres but range from 5 to 320 acres. Most areas of this soil have been drained.

Typically the surface layer is black muck about 7 inches thick. The next 17 inches is black and dark reddish brown muck. The substratum to a depth of 60 inches is gravelly loamy sand and loose stratified sand and gravel. In small areas, the muck is deeper than typical or the underlying material is loamy. Some areas have concentrations of bog iron on the surface or throughout the soil. These areas can be distinguished by their dark red or yellowish red color.

Included with this soil in mapping are areas, 1/2 acre to 2 acres in size, that are too wet to farm. The included soils make up 2 to 5 percent of this map unit.

Permeability is moderately slow to moderately rapid in the muck layer and rapid in the substratum. Available water capacity is moderate or high, and organic matter content is very high. Surface runoff is very slow. The seasonal high water table is at the surface, and water ponds on some areas of this soil.

Most areas of this soil are farmed. Corn and soybeans are the main crops, but special crops and pasture are also grown.

This soil is suited to corn, soybeans, sweet corn, mint, onions, and potatoes. Wetness is a severe limitation for cultivated crops. Tile drains help overcome the wetness, but the tile needs special blinding to keep the sand out. Overdrainage causes excessive subsidence, and increases the hazard of fire, because the muck will burn when dry. Surface runoff from the uplands commonly needs to be diverted away to help correct the wetness. Soil blowing is a hazard when the soil is dry or void of plant cover. Cover crops and crop residue help control soil blowing early in winter and spring, and shrub windbreaks are beneficial throughout the year.

This soil is well suited to grasses for hay and pasture. It is poorly suited to deep-rooted legumes, such as alfalfa, because of the wetness. Overgrazing or grazing when this soil is too wet causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the soil in good condition.

This soil is poorly suited to trees, however, water-tolerant hardwoods commonly ring the perimeter of soil areas. A prolonged high water table is the main limitation. The control and removal of unwanted trees and shrubs can be accomplished by site preparation or by spraying, cutting, and girdling.

The limitation is severe on this soil for building sites because of the ponding. Drainage is difficult to maintain in most areas. In some areas, pumping is the only suitable means of draining. Muck is very unstable for building purposes and piling is needed in places.

The limitation is severe for local roads and streets because of the ponding and low strength. Excavating the muck to an underlying mineral soil and elevating the roadbed in combination with a good drainage system along the roadway helps overcome these limitations.

The limitation is severe for septic tank absorption fields because of the wetness and ponding. Commercial sewers and treatment facilities generally are needed.

This soil is in capability subclass IVw and woodland suitability subclass 4w.

BaA—Blount silt loam, 0 to 3 percent slopes. This soil is nearly level to gently sloping. It is deep and somewhat poorly drained. This soil is on till plains. Areas are broad and irregular in shape. They are dominantly about 20 acres, but range from 4 to 160 acres.

Typically, the surface layer is dark grayish brown silt loam about 9 inches thick. The subsurface layer is grayish brown silt loam about 3 inches thick. The subsoil is about 15 inches thick. The upper part of the subsoil is yellowish brown, mottled, firm clay loam, and the lower part is yellowish brown, mottled, firm silty clay. The substratum to a depth of about 60 inches is yellowish brown, mottled clay loam. In many areas the surface layer is dark brown or very dark grayish brown. In some small areas it is loam. In small areas 3 to 6 inches of the original topsoil has been removed by erosion. In a few small areas are Haskins soils that are similar to this Blount soil, but are coarser textured in the surface layer and upper part of the subsoil. Some small areas of Nappanee soils are along the fringes of areas that border Nappanee soils.

Included with this soil in mapping are small areas of Pewamo silty clay loam in pockets and drainageways. Also included in mapping are a few small, slightly elevated areas of the better drained Morley and Rawson soils and areas of soils, less than 2 acres in size, that are too wet for crop production. The included soils make up 5 to 10 percent of this map unit.

Permeability is slow. Available water capacity is moderate. Organic matter content in the surface layer is moderate. Surface runoff is slow. A perched, seasonal high water table is at a depth of 1 to 3 feet. The surface layer is friable and is easy to till under proper moisture conditions. Erosion is a hazard on the more sloping soils.

Most areas of this soil are farmed. Corn, soybeans, and wheat are the main crops. Many areas are used for hay and pasture, and a few areas are used for woodland.

If this soil is adequately drained, it is well suited to corn, soybeans, and small grain. Wetness is the main limitation that affects use and management. Where drainage is adequate and fertility is maintained, a conservation cropping system that includes row crops most of the time can be used. Large ditches in many areas of this soil help control wetness. Blinding tile with selected materials improves the efficiency of the drainage system. Minimum tillage and crop residue management help maintain tilth and organic matter content of the soil.

This soil is well suited to grasses and legumes for hay or pasture. The heaving of deep-rooted legumes is a problem in some years. Drainage of this soil is necessary to obtain high yields for forage or pasture. Overgrazing or grazing when this soil is too wet causes surface compaction and poor tilth and reduces the infiltration rate of water. Overgrazing also reduces the plant density and plant hardiness. Proper stocking rates, rotation grazing, timely deferment of grazing, and restricted use during wet periods help reduce surface compaction and maintain good tilth and plant densities.

This soil is suited to trees. The limitation is moderate for use of equipment. Water-tolerant species are favored in timber stands. Seedlings survive and grow well if competing vegetation is controlled. The control or removal of unwanted trees and shrubs can be accomplished by site preparation or by spraying, cutting, or girdling.

The limitation is severe on this soil for building sites. The high water table is the main limitation. This soil is difficult to drain. Water moves slowly to tile systems because of the high percentage of clay in the subsoil. However, if an adequate drainage system in combination with storm sewers is installed, the water table can be lowered.

The limitation is severe for local roads and streets because of the frost action and low strength. The upper layers of this soil need to be replaced or covered with a suitable base material if local roads and streets are to function properly.

The limitation is severe for septic tank absorption fields in this soil because of the seasonal high water table and slow permeability. These limitations can be overcome in places by use of the mound system or aerator system and by installing perimeter drains around the filter field after drainage systems have been installed.

This soil is in capability subclass IIw and woodland suitability subclass 3o.

BoA—Boyer loamy sand, 0 to 2 percent slopes. This soil is nearly level and well drained. It is moderately

deep over sand and gravel. This soil is along the edge of extensive outwash plains and on small flats on the tops of ridges between drainageways. It has few to common cobbles on the surface. Areas are irregular in shape. They are dominantly about 20 acres, but range from 5 to 160 acres.

Typically, the surface layer is dark grayish brown loamy sand about 10 inches thick. The subsoil is about 26 inches thick. The upper part of the subsoil is dark yellowish brown, friable loamy sand; the next part is brown and dark yellowish brown, friable sandy loam; and the lower part is dark yellowish brown, friable loamy sand. The substratum to a depth of 60 inches is brown stratified sand and gravelly sand. In some small areas the subsoil has a higher percentage of clay than is typical. Where Boyer soils are adjacent to Shipshe soils, the surface layer is very dark grayish brown and has a higher percentage of coarse fragments than is typical. In some areas the substratum is at a depth of 40 to 60 inches.

Included with this soil in mapping are small areas of Chelsea soils and small areas of soils that have 40 to 75 percent gravel in the surface layer. The included soils make up 10 to 15 percent of this map unit.

Permeability is moderately rapid in the subsoil and very rapid in the underlying material. Available water capacity is low. Organic matter content is moderate. Surface runoff is slow. The seasonal high water table is below a depth of 6 feet. The surface layer is friable and easily tilled through a fairly wide range of soil moisture.

Most areas of this soil are farmed. Many areas are used for corn, soybeans, and small grain. Some areas are used for hay or pasture, and a few areas are used for orchards or are in woodland.

This soil is well suited to corn, soybeans, and small grain. Droughtiness is the main limitation on this soil, and soil blowing is a hazard. Well distributed rainfall, particularly during midseason, is essential for good productivity. This soil is well suited to irrigation, and crop yields can be significantly increased with supplemental water. This soil has slightly higher production potential than the Boyer soils that have 2 to 6 percent slopes. This is because more water is available for plant growth and the hazard of erosion is less on this nearly level soil. Also, less power is required to farm this level soil than the more sloping soils.

Grasses and legumes for hay or pasture are well suited to this soil. Well distributed rainfall increases yields of forage or pasture. Overgrazing or grazing when this soil is too wet causes surface compaction and poor tilth. Overgrazing also reduces the plant density and plant hardiness. Proper stocking rates, rotation grazing, timely deferment of grazing, and restricted use during wet periods help reduce surface compaction and maintain good tilth and plant densities.

This soil is well suited to trees. Seedling mortality is moderate, but some replanting of seedlings is needed in places. Planting early in spring helps seedling survival. Plant competition is moderate. Seedlings survive and grow well if competing vegetation is controlled. The control or removal of unwanted trees and shrubs can be accomplished by site preparation or by spraying, cutting, or girdling.

The limitation is slight on this soil for building sites and for local roads and streets. The limitation is severe for septic tank absorption fields because the filtering quality of the soil is poor. Ground water contamination is possible in some areas because of the moderately rapid permeability.

This soil is in capability subclass IIIs and woodland suitability subclass 3s.

BoB—Boyer loamy sand, 2 to 6 percent slopes. This soil is gently sloping and well drained. It is moderately deep over sand and gravelly sand. This soil is on the side slopes of ridges, knolls, and potholes and also on the side slopes of breaks along drainageways on outwash plains and uplands. It has few to common cobbles on the surface. Areas are dominantly about 20 acres, but range from 5 to 160 acres.

Typically, the surface layer is dark brown loamy sand about 8 inches thick. The subsoil is about 25 inches thick. The upper part of the subsoil is yellowish brown, friable loamy sand, and the lower part is strong brown and reddish brown, friable sandy loam. The substratum to a depth of 60 inches is brown stratified gravelly sand and coarse sand. In some small areas the subsoil has a higher percentage of clay. Where Boyer soils are adjacent to Shipshe soils, the surface layer is very dark grayish brown and has a higher percentage of coarse fragments.

Included with this soil in mapping are a few small areas of Oshtemo soils. Also incuded are small areas of Chelsea soils and soils that have 40 to 75 percent gravel in the surface layer. The included soils make up 10 to 15 percent of this map unit.

Permeability is moderately rapid in the subsoil and very rapid in the underlying material. Available water capacity is low, and organic matter content is moderate. Surface runoff is slow. The seasonal high water table is below a depth of 6 feet. This soil absorbs water readily and is easy to work. The surface layer is friable and easily tilled through a fairly wide range of soil moisture.

Most areas of this soil are farmed. Many areas are used for corn, soybeans, and small grain. Some areas are used for hay or pasture, and a few areas are in woodland.

This soil is suited to corn, soybeans, and small grain. Droughtiness is a limitation and erosion and soil blowing are hazards in areas of this soil. Well distributed rainfall, particularily during midseason, is essential for good productivity. This soil is well suited to irrigation, and crop yields can be significantly increased with supplemental water. Minimum tillage and crop residue management help improve and maintain tilth and organic matter content.

Grasses and legumes for hay or pasture are well suited to this soil and are effective in helping to control

water erosion and soil blowing. Well distributed rainfall increases yields of forage or pasture. Overgrazing reduces the plant density and plant hardiness. Proper stocking rates, rotation grazing, and timely deferment of grazing help reduce surface compaction and maintain good tilth and plant densities.

This soil is well suited to trees. Seedling mortality is moderate. Some replanting of seedlings is needed in places. Planting early in spring helps seedling survival. Plant competition is moderate. Seedlings survive and grow well if competing vegetation is controlled. The control or removal of unwanted trees and shrubs can be accomplished by site preparation or by spraying, cutting, or girdling.

The limitation is slight on this soil for dwellings with or without basements. The limitation is severe for septic tank absorption fields because the filtering quality of the soil is poor. Ground water contamination is possible in some areas because of the moderately rapid permeability.

This soil is in capability subclass IIIs and woodland suitability subclass 3s.

BoC—Boyer loamy sand, 6 to 12 percent slopes. This soil is moderately sloping and well drained. It is moderately deep over sand and gravelly sand. This soil is on the side slopes of ridges, knolls, and potholes and also on the side slopes of breaks along drainageways, on outwash plains, and in morainic areas. It has few to common cobbles on the surface. Areas are irregular in shape and range from 3 to 20 acres.

Typically, the surface layer is grayish brown loamy sand about 7 inches thick. The subsoil is about 21 inches thick. The upper part of the subsoil is brown, friable sandy loam, and the lower part is strong brown and reddish brown, friable sandy loam. The substratum to a depth of 60 inches is brown stratified gravelly sand and coarse sand. In some small areas the subsoil has a higher percentage of clay than typical, or the surface layer has a darker color, or pebbles and cobbles are throughout the solum. In some areas the solum is 40 to 60 inches thick.

Included with this soil in mapping are small areas of Chelsea soils and areas of severely eroded soils that have a surface layer of brown sandy loam. The included soils make up 10 to 15 percent of this map unit.

Permeability is moderately rapid in the subsoil and very rapid in the underlying material. Available water capacity is low, and organic matter content is moderate. Surface runoff is medium. The seasonal high water table is below a depth of 6 feet. This soil absorbs water readily and is easy to work. The surface layer is friable and easily tilled through a fairly wide range of soil moisture.

Some areas of this soil are farmed. Corn, soybeans, small grain, and some hay and pasture are the main crops. Some areas are in woodland or orchards.

This soil is suited to corn, soybeans, and small grain. Droughtiness is a limitation and soil erosion is a hazard for cultivated crops. Slope is a limitation for irrigation. Well distributed rainfall, particularly during midseason, is essential for good productivity. In areas of cultivated crops, conservation management is needed to control erosion and surface runoff. Crop rotation, minimum tillage, terraces, diversions, contour farming, grassed waterways, and grade stabilization structures help prevent excessive soil loss. Returning crop residue to the soil and including cover crops in the cropping system help control erosion and improve and maintain tilth and organic matter content.

Grasses and legumes for hay or pasture are well suited to this soil and are effective in controlling soil blowing and water erosion. Well distributed rainfall helps increase yields of forage or pasture. Overgrazing reduces the plant density and plant hardiness. Proper stocking rates, rotation grazing, and timely deferment of grazing help reduce surface compaction and maintain good tilth and plant densities.

This soil is well suited to trees (fig. 3). Seedling mortality is moderate, but some replanting of seedlings is necessary in places. Planting early in spring helps seedlings survive. Plant competition is moderate. Seedlings survive and grow well if competing vegetation is controlled. The control or removal of unwanted trees and shrubs can be accomplished by site preparation or by spraying, cutting, or girdling.

Because of slope, the limitation is moderate for dwellings with or without basements. Areas should be graded to modify slope, and buildings should be designed to complement slope. Disturbed areas should be revegetated soon after construction to prevent erosion. Topsoil should be stockpiled and replaced on disturbed areas.

The limitation is moderate for local roads and streets because of the slope. Roadways should be cut and filled or designed to complement the slope.

The limitation is severe for septic tank absorption fields because the filtering quality of the soil is poor. The filter field should be graded to modify slope. Ground water contamination is possible in some areas because of the moderately rapid permeability.

This soil is in capability subclass IIIe and woodland suitability subclass 3s.

BoD—Boyer loamy sand, 12 to 18 percent slopes. This soil is strongly sloping and well drained. It is moderately deep over sand and gravelly sand. This soil is on the side slopes of ridges, knolls, and potholes. It is also on the side slopes of breaks along drainageways on outwash plains and in morainic areas. This soil has few to common cobbles on the surface. Areas are irregular in shape and range from 3 to 10 acres.

Typically, the surface layer is grayish brown loamy sand about 6 inches thick. The subsoil is about 18 inches thick. The upper part of the subsoil is brown, friable sandy loam, and the lower part is strong brown and reddish brown, friable sandy loam. The substratum

Figure 3.—Dense stand of timber on Boyer loamy sand, 6 to 12 percent slopes.

to a depth of 60 inches is brown stratified gravelly sand and coarse sand. In some small areas, the surface layer is sandy clay loam; or the soil is shallow, and loose sand and gravelly sand are at a depth of 18 to 24 inches; or the subsoil has a higher percentage of clay. Some areas are sandier than typical, and some areas have a solum 40 to 60 inches thick. Where Boyer soils are adjacent to Shipshe soils, the surface layer has a higher percentage of coarse fragments.

Included with this soil in mapping are a few small areas of Boyer soils that have slopes of 6 to 12 percent, areas of soils in the extreme northwestern part of the county that have slopes as much as 35 percent, and small areas of soils that have 40 to 75 percent medium and large gravel on the surface. Also included are areas of severely eroded soils that have a surface layer of brown sandy loam. The included soils make up 10 to 15 percent of this map unit.

Permeability is moderately rapid in the subsoil and very rapid in the underlying material. Available water capacity is low, and organic matter content is moderate. Surface runoff is medium. The seasonal high water table is below a depth of 6 feet. This soil absorbs water readily and is easy to work. The surface layer is friable and easily tilled through a fairly wide range of soil moisture.

Most areas of this soil are used for hay and pasture. Some areas are in woodland.

This soil is poorly suited to corn, soybeans, and small grain because erosion is a hazard. Most row crops are grown so that stands of grasses and legumes can be reestablished. Droughtiness is a limitation on this soil;

however, irrigation is severely limited and tillage is difficult because of the slope. In areas of cultivated crops, conservation management is needed to control erosion and surface runoff. Minimum tillage, diversions, grassed waterways, and returning crop residue to this soil help prevent excessive soil loss. A cropping system that includes grasses and legumes for hay and pasture most of the time is effective in reducing runoff and controlling erosion.

Grasses and legumes for hay and pasture are well suited to this soil and are effective in controlling soil blowing and water erosion. Haying operations are difficult because of the slope. Overgrazing pasture in areas of this soil causes excessive runoff and poor tilth. Proper stocking rates, pasture rotation, and timely deferment of grazing help keep the pasture and soil in good condition.

This soil is well suited to trees. Seedling mortality is moderate, but some replanting of seedlings is needed in places. Planting early in spring helps seedlings survive. Plant competition is moderate. Seedlings survive and grow well if competing vegetation is controlled. The control or removal of unwanted trees and shrubs can be accomplished by site preparation or by spraying, cutting, or girdling.

The limitation is severe for building sites because of the slope. Areas need to be graded to modify slope, and buildings designed to complement slope. Disturbed areas should be revegetated soon after construction to prevent erosion. Topsoil should be stockpiled and replaced on disturbed areas.

The limitation is severe for local roads and streets because of the slope. Roadways need to be cut and filled or designed to complement the slope.

The limitation is severe for septic tank absorption fields. The filter field should be graded to modify the slope. Ground water contamination is possible in some areas because of the very rapid permeability.

This soil is in capability subclass IVe and woodland suitability subclass 3s.

Bp—Brady sandy loam. This soil is nearly level, deep, and somewhat poorly drained. It is on broad, irregularly shaped flats between drainageways and depressions on glacial outwash plains. Areas are dominantly about 20 acres, but range from 5 to 80 acres.

Typically, the surface layer is very dark grayish brown sandy loam about 9 inches thick. The subsoil is about 44 inches thick. The upper part of the subsoil is brown, friable loamy sand; the next part is brown, mottled sandy loam; and the lower part is yellowish brown and grayish brown, friable and firm, mottled sandy loam and sandy clay loam. The underlying material to a depth of about 60 inches is brown coarse sand and gravelly sand. In some small areas the subsoil contains more than 8 inches of sandy clay loam.

Included with this soil in mapping are a few small areas of Gilford sandy loam in small drainageways and depressions, small areas of Bronson and Oshtemo soils on slightly higher positions in the landscape, and small areas of Homer soils. The included soils make up 5 to 10 percent of this map unit.

Permeability is moderately rapid in the upper part of the profile and rapid and very rapid in the underlying material. Available water capacity and organic matter content are moderate. Surface runoff is slow. The seasonal high water table is at a depth of 1 to 3 feet. The surface layer is friable and easily tilled through a wide range of soil moisture.

Most areas of this soil are farmed. Corn, soybeans, and wheat are the main crops. A few areas are used for hay and pasture, and a few areas are in woodland.

If this soil is adequately drained, it is well suited to corn, soybeans, and small grain. Wetness is the main limitation that affects the use and management. Many large ditches in areas of this soil help control wetness. Minimum tillage, crop residue management, and cover crops help maintain organic matter and good tilth.

This soil is well suited to grasses and legumes for hay or pasture. Drainage is needed to obtain high yields of forage or pasture. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Overgrazing also reduces the plant density and plant hardiness. Proper stocking rates, rotation grazing, timely deferment of grazing, and restricted use during wet periods help reduce surface compaction and maintain good tilth and plant densities.

This soil is suited to trees. Planting and harvesting operations are often delayed because of the wetness. Plant competition is moderate. Water-tolerant species are favored in timber stands. Seedlings survive and grow well when competing vegetation is controlled. The control or removal of unwanted trees and shrubs can be accomplished by site preparation or by spraying, cutting, or girdling.

The limitation is severe on this soil for building sites. The high water table is the main limitation. If an adequate drainage system in combination with storm sewers is installed, the water table can be lowered.

The limitation is severe for local roads and streets because of the frost action. Proper drainage of the roadway and mixing the base material with soil additives help overcome this limitation.

The limitation is severe for septic tank absorption fields in this soil because of the high water table and the poor filtering quality of the soil. Increasing the depth of soil material above the water table or installing perimeter drains around the filter field after drainage has been installed help overcome these limitations. Ground water contamination is possible because of the very rapid permeability.

This soil is in capability subclass IIw and woodland suitability subclass 3o.

BtA—Brems sand, 0 to 3 percent slopes. This soil is nearly level and gently sloping, deep, and moderately

well drained. It is on rises adjacent to well drained, higher lying sandy soils and in depressions and swales of outwash areas. Areas range from 3 to 10 acres.

Typically, the surface layer is dark brown sand about 7 inches thick. The subsurface layer is yellowish brown sand about 6 inches thick. The subsoil is yellowish brown, light yellowish brown, and brown mottled sand about 37 inches thick. The underlying material to a depth of 60 inches is loose, mottled fine sand.

Included with this soil in mapping are small areas of Plainfield soils on higher lying positions than this Brems soil, small areas of Granby and Gilford soils in depressions, and small areas of soils that have slopes of more than 3 percent. The included soils make up 5 to 10 percent of this map unit.

Permeability is rapid. Available water capacity and organic matter content are low. Surface runoff is slow. The surface layer is generally slightly acid to strongly acid, except in areas that have been limed. The seasonal high water table is at a depth of 2 to 3 feet. The surface layer is very friable and easily tilled through a wide range of soil moisture.

Most areas of this soil are used for hay or pasture or for woodland. A few irrigated areas are used for row crops, and a few areas are used for special crops.

This soil is poorly suited to corn, soybeans, and small grain because of droughtiness. Soil blowing is a hazard where the soil is void of vegetation. Row crops are generally grown only where irrigation has been installed.

Grasses and legumes for hay and pasture are suited to this soil. Proper stocking rates, pasture rotation, and timely deferment of grazing help keep the pasture and soil in good condition.

This soil is suited to trees, especially pine trees. It is moderately limited by seedling mortality. Water-tolerant species are favored in timber stands. Seedlings survive and grow well if competing vegetation is controlled. The control and removal of unwanted trees and shrubs can be accomplished by site preparation or by spraying, cutting, or girdling.

The limitation is moderate on this soil for dwellings without basements and severe for dwellings with basements because of the seasonal high water table at a depth of 2 to 3 feet. If an adequate drainage system in combination with storm sewers can be installed, the water table can be lowered.

The limitation is moderate for local roads and streets because of the wetness.

The limitation is severe for septic tank absorption fields because of the seasonal high water table and the poor filtering quality of this soil. Increasing the depth of soil material above the water table or installing perimeter drains around the filter helps to overcome the wetness. Ground water contamination is possible because of the rapid permeability.

This soil is in capability subclass IVs and woodland suitability subclass 3s.

BxA—Bronson sandy loam, 0 to 3 percent slopes. This soil is nearly level to gently sloping, deep, and moderately well drained. It is on irregularly shaped flats between drainageways and depressions on glacial outwash plains. Areas are small and narrow adjacent to poorly drained areas. Areas of this soil are dominantly about 20 acres, but range from 3 to 80 acres.

Typically, the surface layer is dark grayish brown sandy loam about 9 inches thick. The upper 5 inches of the subsurface layer is yellowish brown sandy loam, and the lower 6 inches is strong brown loamy sand. The subsoil is about 42 inches thick. The upper part of the subsoil is brown and yellowish brown, mottled, friable gravelly sandy loam and sandy loam, and the lower part is dark brown, mottled, friable loamy sand and sandy loam. The substratum to a depth of 74 inches is brown gravelly sand.

Included with this soil in mapping are small areas of Oshtemo soils on higher lying positions than this Bronson soil and Brady soils on lower lying positions. The included soils make up 5 to 10 percent of this map unit.

Permeability is moderately rapid in the upper part of the profile and rapid in the lower part. Available water capacity and organic matter content are moderate. Surface runoff is slow. The seasonal high water table is at a depth of 2 to 3.5 feet. The surface layer is friable and easily tilled through a wide range of soil moisture.

Most areas of this soil are farmed. Corn, soybeans, and wheat are the main crops. A few areas are used for hay or pasture or are in woodland.

This soil is suited to corn, soybeans, and small grain. Droughtiness is the main limitation during dry periods in the growing season. Well distributed rainfall, particularily during midseason, is essential for good productivity. This soil is suited to irrigation and crop yields can be significantly increased with supplemental water. Minimum tillage and crop residue management help improve and maintain tilth and organic matter content.

Grasses and legumes for hay or pasture are well suited to this soil. Well distributed rainfall increases yields for forage or pasture. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Overgrazing also reduces the plant density and plant hardiness. Proper stocking rates, rotation grazing, timely deferment of grazing, and restricted use during wet periods help reduce surface compaction and maintain good tilth and plant densities.

This soil is well suited to trees. It is moderately limited by plant competition. Water-tolerant species are favored in timber stands. Seedlings survive and grow well if competing vegetation is controlled. The control or removal of unwanted trees and shrubs can be accomplished by site preparation or by spraying, cutting, or girdling.

The limitation is moderate on this soil for dwellings without basements and severe for dwellings with basements because of the seasonal high water table. If an adequate drainage system in combination with storm sewers can be installed, the water table can be lowered.

The limitation is severe for local roads and streets because of frost action. This limitation can possibly be overcome by proper drainage of the roadway and by mixing soil additives with the base material.

The limitation is severe for septic tank absorption fields because of the wetness and the poor filtering quality of this soil. Increasing the depth of soil material above the water table or installing perimeter drains around the filter field after drainage is installed helps overcome the wetness. Ground water contamination is possible because of the moderately rapid permeability.

This soil is in capability subclass IIs and woodland suitability subclass 3o.

ChB—Chelsea fine sand, 1 to 6 percent slopes. This soil is nearly level and gently sloping, deep, and excessively drained. It in on convex, undulating outwash areas and on side slopes of knolls and ridges on uplands. Areas are irregular in shape. They are dominantly about 5 acres, but range from 3 to 80 acres.

Typically, the surface layer is brown fine sand about 10 inches thick. Below this, to a depth of 36 inches, is yellowish brown sand and sand. Next, to a depth of 70 inches, is yellowish brown sand that has bands of brown loamy sand 1/4 to 1 inch thick. The underlying material to a depth of 80 inches is light yellowish brown sand. In some areas, the surface layer is sandy loam, or the underlying material below a depth of 60 inches is loam or silty clay loam. In small areas, the total thickness of the bands above a depth of 60 inches is more than 6 inches.

Included with this soil in mapping are areas of soils that have slopes of more than 6 percent and small areas of Plainfield, Oshtemo, and Boyer soils. The included soils make up 5 to 10 percent of this map unit.

Permeability is rapid. Available water capacity and organic matter content are low. Surface runoff is slow. The seasonal high water table is below a depth of 6 feet. The surface layer is very friable and easily tilled through a wide range of soil moisture.

Most areas of this soil are farmed. Many areas are used for corn, soybeans, and small grain. Some areas are used for hay or pasture, and a few areas are in woodland.

This soil is suited to small grain, but is poorly suited to corn and soybeans. Corn and soybeans can be grown, but yields are commonly low because of the droughtiness. Early maturing row crops are less affected by the droughtiness. Wheat is well adapted to this soil. This soil is well suited to irrigation, and crop yields can be significantly increased with supplemental water. Soil blowing is a problem. Traction is poor for farm machinery. Frequent applications of fertilizer are necessary because of the rapid leaching of nutrients. Minimum tillage and crop residue management help improve and maintain tilth and organic matter content.

Grasses and legumes for hay and pasture are suited to this soil and help control soil blowing. Proper stocking rates, pasture rotation, and timely deferment of grazing help keep the pasture and soil in good condition.

This soil is suited to trees. Christmas trees, especially, are well adapted. The establishment of trees on this soil is moderately limited by seedling mortality. Seedlings survive and grow well if competing vegetation is controlled. The control and removal of unwanted trees and shrubs can be accomplished by site preparation or by spraying, cutting, or girdling.

The limitation is slight on this soil for building sites and for local roads and streets. The limitation is severe for septic tank absorption fields because the filtering quality of this soil is poor. Ground water contamination is possible because of the rapid permeability.

This soil is in capability subclass IVs and woodland suitability subclass 3s.

ChC—Chelsea fine sand, 6 to 12 percent slopes. This soil is moderately sloping, deep, and excessively drained. It is on convex, undulating outwash areas and on side slopes of knolls and ridges on uplands. Areas are irregular in shape. They range from 3 to 10 acres.

Typically, the surface layer is brown fine sand about 7 inches thick. Below this, to a depth of 34 inches, is yellowish brown fine sand and sand. Next, to a depth of 70 inches, is sand that has bands of brown loamy sand 1/4 to 1 inch thick. The underlying material to a depth of 80 inches is light yellowish brown sand. In some areas, the underlying material is loam or silty clay loam below a depth of 60 inches, or the surface layer is sandy loam, or the total thickness of the bands above 60 inches is more than 6 inches.

Included with this soil in mapping are areas of soils that have slopes as much as 18 percent, areas that have a severely eroded surface layer, and small areas of Boyer, Oshtemo, and Plainfield soils. The included soils make up 5 to 10 percent of this map unit.

Permeability is rapid. Available water capacity and organic matter content are low. Surface runoff is medium. The seasonal high water table is below a depth of 6 feet. The surface layer is very friable and easily tilled through a wide range of soil moisture.

Some areas of this soil are farmed. Most areas are used for hay or pasture, and a few areas are in woodland.

This soil is generally not suited to corn and soybeans because of the droughtiness. Wheat, however, is well adapted to this soil. Erosion and soil blowing are major hazards. Irrigation is poorly suited because of the slopes. Traction is poor for farm machinery. Frequent applications of fertilizer are needed because of the rapid leaching of nutrients. Minimum tillage and crop residue management help improve and maintain tilth and organic matter content.

Grasses and legumes for hay and pasture are suited to this soil, and they help control soil blowing and erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help keep the pasture and soil in good condition.

This soil is suited to trees. Christmas trees and orchard trees are especially adapted to this soil. The establishment of trees on this soil is moderately limited by seedling mortality. Seedlings survive and grow well if competing vegetation is controlled. The control and removal of unwanted trees and shrubs can be accomplished by site preparation or by spraying, cutting, or girdling.

The limitation is moderate on this soil for buildings with or without basements because of the slope. Areas should be graded to modify slope, and buildings should be designed to complement slope. Topsoil should be stockpiled and replaced on disturbed areas, and these areas should be revegetated soon after construction to prevent erosion.

The limitation is moderate for local roads and streets because of the slope. Roads should be cut and filled or designed to complement slope.

The limitation is severe for septic tank absorption fields because this soil has poor filtering quality. Ground water contamination is possible in some areas because of the rapid permeability.

This soil is in capability subclass VIs and woodland suitability subclass 3s.

CrA—Conover loam, 0 to 3 percent slopes. This soil is nearly level and gently sloping. It is deep, and somewhat poorly drained. This soil is on irregularly shaped flats on broad undulating moraines and narrow meandering drainageways on uplands. A few scattered cobbles are on the surface in many areas. Areas are dominantly about 20 acres but range from 5 to 160 acres.

Typically, the surface layer is very dark grayish brown loam about 9 inches thick. The subsurface layer is grayish brown sandy loam about 4 inches thick. The subsoil is about 23 inches thick. The upper part of the subsoil is yellowish brown, mottled sandy loam; the next part is grayish brown and yellowish brown, mottled clay loam; and the lower part is yellowish brown, mottled loam. The substratum to a depth of 60 inches is brown mottled loam. In some areas, the surface layer is dark grayish brown or the upper part of the subsoil is not mottled, or the upper layers are sandy and 10 to 36 inches thick.

Included with this soil in mapping are narrow, elongated areas of Rensselaer soils in small drainageways, small areas of Whitaker soils, and areas of soils 1/2 acre to 2 acres in size in which most crops are severely damaged by wetness. The included soils make up 5 to 10 percent of this map unit.

Permeability is moderately slow. Available water capacity and organic matter content are high. Surface runoff from cultivated areas is slow. The seasonal high water table is at a depth between 1 foot and 2 feet. The surface layer is friable and easy to work under proper moisture conditions.

Most areas of this soil are farmed. Many areas are used for corn, soybeans, or small grain. A few areas are used for hay or pasture or are in woodland.

This soil is well suited to corn, soybeans, and small grain. Drainage has been established in most areas. Wetness is the major limitation in use and management. Excessive water can be removed by tile drains or surface drains. If drainage is adequate, a conservation cropping system that includes row crops most of the time is used. Open ditches in many areas of this soil help control wetness. Minimum tillage, crop residue management, and cover crops help improve and maintain tilth and organic matter content.

Grasses and legumes for hay and pasture are well suited to this soil. Drainage of this soil is necessary to obtain high yields of forage or pasture. The selection of legumes depends on completeness of drainage. Alfalfa is not well suited because of the wetness and frost heaving. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Overgrazing also reduces the plant density and plant hardiness. Proper stocking rates, rotation and timely deferment of grazing, and restricted use during wet periods help reduce surface compaction and maintain good tilth and plant densities.

This soil is suited to trees. The limitation is moderate for the use of equipment. Harvesting and logging operations are often delayed because of the wetness. The establishment of trees is moderately limited by plant competition. Water-tolerant species are favored in timber stands. Seedlings survive and grow well if competing vegetation is controlled. The control or removal of unwanted trees and shrubs can be accomplished by site preparation or by spraying, cutting, or girdling.

The limitation is severe on this soil for building sites because of the seasonal high water table at a depth of 1 foot to 2 feet. Installing an adequate drainage system in combination with storm sewers helps lower the water table. Houses without basements are better suited on this soil than houses with basements.

The limitation is severe for local roads and streets because of the frost action and low strength. Drainage is needed for roads to lower the water table and to reduce frost action. The base needs to be strengthened with a more suitable material.

The limitation is severe for septic tank absorption fields because of the moderately slow permeability and the seasonal high water table. These limitations can be overcome in places by increasing the depth of soil material above the water table, by installing perimeter drains around the filter field, or by installing a sanitary sewer system after drainage is installed.

This soil is in capability subclass IIw and woodland suitability subclass 3o.

Ed—Edwards muck. This soil is nearly level and very poorly drained. It is moderately deep or deep over marl. This soil is in depressional areas on uplands and outwash plains and is commonly along lakes or major watercourses. Surface runoff from adjacent higher lying areas frequently ponds on this soil. Areas are irregular in

shape. They are dominantly about 20 acres but range from 3 to 100 acres.

Typically the surface layer is black muck about 11 inches thick. Below this is black and dark reddish brown muck about 14 inches thick. The substratum to a depth of 60 inches is grayish brown and light gray marl that has many shell fragments. Some small areas are underlain with a layer of coprogenous material.

Included with this soil in mapping are small areas of Martisco soils that have less than 16 inches of organic material over marl, small areas of Houghton soils that have more than 50 inches of organic material, and small narrow strips of very poorly drained mineral soils surrounding this Edwards soil. The included soils make up 5 to 10 percent of this map unit.

Permeability is moderately slow to moderately rapid in the organic material and variable in the marl. Available water capacity and organic matter content are very high. Surface runoff is very slow. Water is ponded in some areas during a part of the year. If drained, this soil has a friable surface layer that is easy to till under proper moisture conditions.

Very few areas of this soil are farmed. Some small areas have been drained. Undrained areas are dominantly used for wetland wildlife habitat, but some areas are used for permanent pasture. The natural permanent vegetation on this soil provides good habitat for wildlife. Wildlife benefit from the abundance of protective cover and from the seed-bearing woody shrubs.

If this soil is drained, it is suited to corn, soybeans, and special crops. The wetness is a serious limitation. Drainage outlets generally are not available if the water level of adjacent lakes and streams is the same as the water table in the soil. Excessive water can be removed in places by a pumping system in conjunction with open ditches, tile drains, and surface drains. Drainage can increase the hazard of oxidation and subsidence of the organic material. Fire is a hazard when the organic material is dry because the muck will burn.

Certain areas of this undrained soil are suited to pasture. The natural vegetation is sedges, cattails, and water-tolerant trees and shrubs. Since most areas are depressional and do not have drainage outlets, drainage commonly is not feasible. Reed canarygrass is well suited to pasture on these soils.

This soil is poorly suited to trees, however, water-tolerant hardwoods commonly are around the perimeter of soil areas. The prolonged high water table is a limitation. The control and removal of unwanted trees and shrubs can be accomplished by site preparation or by spraying, cutting, and girdling.

The limitation is severe on this soil for building sites because of the excess humus and susceptibility to ponding. The muck is very unstable for building purposes, and the marl is variable in composition and depth. Piling is generally necessary, assuming a mineral layer can be reached beneath the marl. Most areas are difficult to drain because this soil is commonly in the lowest lying part of the landscape. Pumping is the only suitable means of draining some areas.

The limitation is severe on this soil for local roads and streets because of the excess humus and susceptibility to ponding. Excavating the muck and marl to an underlying mineral soil and elevating the roadbed, in combination with proper drainage of the roadway, help overcome these limitations.

The limitation is severe for septic tank absorption fields because of the ponding. Commercial sewers and treatment facilities are generally needed.

This soil is in capability class V and woodland suitability subclass 4w.

Gf—Gilford sandy loam. This soil is nearly level, deep, and very poorly drained. It is in broad, depressional areas on glacial outwash plains. Surface runoff from adjacent higher lying areas frequently ponds on the surface. Areas are broad and irregular in shape. They are dominantly about 20 acres but range from 5 to 160 acres.

Typically, the surface layer is black sandy loam about 12 inches thick. The subsoil is about 24 inches thick. The upper part of the subsoil is gray and dark gray, mottled, friable sandy loam, and the lower part is dark gray, mottled, firm sandy clay loam. The substratum to a depth of 70 inches is dark gray loamy sand, and below this to a depth of 80 inches it is dark grayish brown coarse sand and fine gravelly sand. In a few, small areas the subsoil is sandy clay loam, or the surface layer is mucky sandy loam, or the solum is more than 40 inches thick. Small areas of this soil have a deposit of loamy overwash 10 to 20 inches thick.

Included with this soil in mapping are a few small areas of Brady sandy loam on the slightly higher spots within the depressions, a few areas of soils that are shallow over loose sand and gravel, and areas 1/2 acre to 2 acres in size that are too wet for common crops. Areas 1/2 acre to 5 acres in size that contain reddish brown or yellowish red iron accumulations or iron nodules are also included. The included soils make up 5 to 10 percent of this map unit.

Permeability is moderately rapid in the subsoil and rapid in the underlying material. Available water capacity is moderate. Organic matter content is high in the surface layer. Surface runoff is very slow or ponded (fig. 4). The surface layer is friable and easy to till under proper moisture conditions.

Most areas of this soil are farmed. Corn, soybeans, and wheat are the major crops. A few areas are used for hay or pasture or are in woodland.

If this soil is adequately drained, it is well suited to corn, soybeans, and small grain. Wetness is the main limitation that affects the use and management. Excessive water can be removed by open ditches, tile drains, surface drains, pumping, or a combination of these practices. When tile is laid in the gravelly sand and sand substratum, special blinding or filtering material is needed to keep sand from clogging the tile. This soil

Figure 4.—A pit pond constructed in an area of very poorly drained Gilford sandy loam provides a dependable source of water.

becomes droughty if the water table is lowered excessively. If drained and properly managed, this soil is suited to intensive row cropping. Minimum tillage and crop residue management help improve and maintain tilth and organic matter content.

Grasses and legumes for hay or pasture are well suited to this soil. Drainage is needed to obtain high yields for forage or pasture. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Overgrazing also reduces the plant density and plant hardiness. Proper stocking rates, rotation grazing, timely deferment of grazing, and restricted use during wet periods help reduce surface compaction and maintain good tilth and plant densities.

This soil is suited to trees. The limitation is severe for use of equipment. Harvesting and logging operations are delayed to dry seasons of the year or when the ground is frozen. Plant competition, seedling mortality, and the windthrow hazard are severe. Water-tolerant species are favored in timber stands. Seedlings survive and grow well if competing vegetation is controlled by cutting, spraying, or girdling.

The limitation is severe on this soil for building sites because of the ponding. Drainage is difficult in most areas because this soil is commonly in the lowest lying part of the landscape. Suitable outlets for drainage systems, such as storm sewers, are not available in areas and pumping is needed.

The limitation is severe for local roads and streets because of the ponding and high potential for frost action. Drainage is needed for roads to lower the water table and reduce frost action.

The limitation is severe for septic tank absorption fields because of the ponding and the poor filtering quality of this soil. Commercial sewer systems are generally needed.

This soil is in capability subclass IIw and woodland suitability subclass 4w.

Gr—Granby loamy fine sand. This soil is nearly level, deep, and very poorly drained. It is on flats and in depressions on broad outwash plains. Surface runoff from

the adjacent, higher lying areas frequently ponds on this soil. Areas are broad and irregular in shape. They are dominantly about 80 acres but range from 5 to 160 acres.

Typically, the surface layer is about 11 inches thick. It is about 8 inches of very dark brown loamy fine sand over about 3 inches of very dark grayish brown loamy fine sand. The underlying material to a depth of about 60 inches is grayish brown, dark grayish brown, and gray fine sand. In small areas, 2 to 4 inches of muck is on the surface. A few small areas are somewhat poorly drained, brighter colored than typical, and generally in long narrow strips between the Granby and Plainfield soils.

Included with this soil is mapping are small areas of Gilford soils on positions similar to this Granby soil and small areas of Brems soils on slightly higher positions. The included soils make up 5 to 10 percent of this map unit.

Permeability is rapid. Available water capacity is low. Organic matter content is high in the surface layer. Surface runoff is very slow or ponded. The seasonal high water table is at the surface, or water is ponded in places during wet seasons. The surface layer is friable and is easy to till under proper moisture conditions.

Some areas of this soil are farmed. Corn, soybeans, and wheat are major crops. A few areas are used for hay or pasture or are in woodland.

If this soil is adequately drained, it is suited to corn, soybeans, and small grain. Wetness is the main limitation that affects the use and management. Excessive water can be removed by open ditches, tile drains, surface drains, pumping, or a combination of these practices. When tile is laid in this soil, special blinding or filtering material is needed to keep sand from clogging the tile. This soil becomes droughty if the water table is lowered excessively. If drained and properly managed, this soil is suited to row cropping most of the time. Minimum tillage and crop residue management help improve and maintain tilth and organic matter content.

This soil is well suited to grasses and legumes for hay or pasture. Drainage is necessary to obtain high yields for forage or pasture. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Overgrazing also reduces the plant density and plant hardiness. Proper stocking rates, rotation and timely deferment of grazing, and restricted use during wet periods help reduce surface compaction and maintain good tilth and plant densities.

This soil is suited to trees. The limitation is severe for use of equipment. Plant competition, seedling mortality, and the windthrow hazard are severe. Water-tolerant species are favored in timber stands. Seedlings survive and grow well if competing vegetation is controlled.

The limitation is severe on this soil for building sites because of the ponding. Drainage is difficult in most areas because this soil is commonly in the lowest lying part of the landscape. Suitable outlets for drainage systems, such as storm sewers, are generally not available and pumping is needed.

The limitation is severe for local roads and streets because of the ponding. Drainage is needed to lower the water table.

The limitation is severe for septic tank absorption fields because of the ponding and poor filtering quality of this soil. Commercial sewer systems are generally needed.

This soil is in capability subclass IIIw and woodland suitability subclass 4w.

HaA—Haskins loam, 0 to 3 percent slopes. This soil is nearly level to gently sloping, deep, and somewhat poorly drained. It is on flats and on leading edges of slopes on uplands. Areas are broad and irregular in shape. They are dominantly about 20 acres but range from 5 to 160 acres.

Typically, the surface layer is dark grayish brown loam about 8 inches thick. The subsurface layer is light brownish gray, mottled loam about 5 inches thick. The subsoil is about 29 inches thick. The upper part of the subsoil is grayish brown and light olive brown, mottled, friable and firm sandy clay loam, and the lower part is brown, mottled, firm clay. The substratum to a depth of 60 inches is yellowish brown clay.

Included with this soil in mapping are small areas of Blount soils in the same landscape positions as this Haskins soil, and small areas of Rawson soils on rises. Also included are a few small, elongated areas of Pewamo soils in shallow depressions and drainageways. The included soils make up 5 to 10 percent of this map unit.

Permeability is moderate in the upper part of the profile and slow or very slow in the lower part. Available water capacity and organic matter content are moderate. Surface runoff is slow. The seasonal high water table is 1 foot to 2.5 feet. The surface layer is friable and easy to work under proper moisture conditions.

Most areas of this soil are farmed. Many areas are used for corn, soybeans, or small grain. A few areas are used for hay or pasture or are in woodland.

This soil is well suited to corn, soybeans, and small grain. Wetness is a limitation that affects use and management. Drainage has been established in most areas so that crops can be grown. Additional drainage is needed in many areas. Excessive water can be removed by tile drains or surface drains. If drainage is adequate, a conservation cropping system that includes row crops most of the time is used. Minimum tillage, crop residue management, and cover crops help improve and maintain tilth and organic matter content.

Grasses and legumes for hay and pasture are well suited to this soil. Drainage is needed to obtain high yields for forage or pasture. The selection of legume depends on completeness of drainage. Alfalfa is not well suited because of wetness and frost heaving. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Overgrazing also reduces the plant density and plant hardiness. Proper stocking rates,

rotation grazing, timely deferment of grazing, and restricted use during wet periods help reduce surface compaction and maintain good tilth and plant densities.

This soil is suited to trees. The limitation is moderate for plant competition. Seedlings survive and grow well if competing vegetation is controlled. The control or removal of unwanted trees and shrubs can be accomplished by site preparation or by spraying, cutting, or girdling.

The limitation is severe on this soil for building sites because of the seasonal high water table at a depth of 1 foot to 2.5 feet. If an adequate drainage system in combination with storm sewers is installed, the water table can be lowered.

The limitation is severe for local roads and streets because of the frost action, wetness, and low strength. Drainage is needed for roads to lower the water table so that frost action can be reduced. The base material needs strengthening with a more suitable material so that it can support heavier loads.

The limitation is severe for septic tank absorption fields because of the slow permeability and wetness. Increasing the depth of soil material above the water table, installing perimeter drains around the filter field, and installing a sanitary sewer system where drainage has been installed help overcome these limitations.

This soil is in capability subclass IIw and woodland suitability subclass 2o.

HdA—Hillsdale sandy loam, 0 to 2 percent slopes. This soil is nearly level, deep, and well drained. It is in nearly level areas on summits and at the base of slopes on uplands. These soils have few to common cobbles on the surface. Areas are generally broad and irregular in shape. They are dominantly about 20 acres but range from 4 to 160 acres.

Typically, the surface layer is dark grayish brown sandy loam about 8 inches thick. The subsurface layer is yellowish brown sandy loam about 8 inches thick. The subsoil is about 55 inches thick. The upper part of the subsoil is strong brown and yellowish brown, friable, sandy loam, and the lower part is yellowish brown and brown, friable loamy sand. The substratum to a depth of 80 inches is yellowish brown loamy sand. In areas of this soil the subsoil and substratum are finer textured than typical. In some areas pockets and strata of sand and gravel are present between the subsoil and substratum, or stratified sand, silt, or gravel are in the subsoil and substratum, or the depth to the substratum is less than 42 inches.

Included with this soil in mapping are small areas of Conover soils in narrow drainageways, soils that have slopes as much as 4 percent, and soils that are in drainageways or depressions and have a darker surface layer than this Hillsdale soil. The included soils make up 5 to 10 percent of this map unit.

Permeability is moderate. Available water capacity and organic matter content are moderate. Surface runoff from cultivated areas is slow. The surface layer is friable and easily tilled through a fairly wide range of soil moisture.

Most areas of this soil are farmed. Many areas are used for corn, soybeans, and small grain. Some areas are used for hay or pasture, and a few areas are in orchards or woodland.

This soil is well suited to corn, soybeans, and small grain. The main management needs are soil moisture conservation and improvement of organic matter content and fertility. Droughtiness is a limitation during seasons of prolonged, low rainfall, particularly when shallow-rooted crops are grown. Minimum tillage, crop rotation, cover crops, crop residue, and green manure crops help maintain tilth and organic matter content and help control loss of soil moisture.

Grasses and legumes for hay or pasture are well suited to this soil. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Overgrazing also reduces the plant density and plant hardiness. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help reduce surface compaction and maintain good tilth and plant densities.

This soil is well suited to trees. The limitation is moderate for plant competition. Seedlings survive and grow well if competing vegetation is controlled. The control or removal of unwanted trees and shrubs can be accomplished by site preparation or by spraying, cutting, or girdling.

The limitation is slight on this soil for building sites. Placing drain tile around foundations and backfilling along the foundation wall with sand and gravel are generally needed.

The limitation is moderate for local roads and streets because of the frost action. Drainage ditches are needed, and the base material needs to be strengthened with a more suitable material if roads and streets are to function properly.

The limitation is moderate for septic tank absorption fields. Increasing the size of the filter field helps overcome moderate permeability in this soil.

This soil is in capability subclass IIs and woodland suitability subclass 1o.

HdB—Hillsdale sandy loam, 2 to 6 percent slopes. This soil is gently sloping, deep, and well drained. It is in areas having undulating slopes on till plains and in areas on the narrow breaks along drainageways and depressions on uplands. This soil has few to common cobbles on the surface. Areas are generally broad and irregular in shape. They are dominantly about 30 acres but range from 5 to 80 acres.

Typically, the surface layer is dark brown sandy loam about 10 inches thick. The subsurface layer is yellowish brown sandy loam about 3 inches thick. The subsoil is about 57 inches thick. The upper part of the subsoil is dark yellowish brown, strong brown, and yellowish

brown, friable sandy loam, and the lower part is brown, friable loamy sand. The substratum to a depth of 80 inches is yellowish brown loamy sand. In some areas, the depth to the substratum is less than 42 inches, or the subsoil and substratum have a texture that is finer than typical, or pockets and strata of sand and gravel are present between the subsoil and substratum.

Included with this soil in mapping are small areas of Wawasee and Martinsville soils on positions similar to this Hillsdale soil and small areas of Conover soils in narrow drainageways. The included soils make up 5 to 10 percent of this map unit.

Permeability is moderate. Available water capacity and organic matter content are moderate. Surface runoff from cultivated areas is slow. The surface layer is friable and easily tilled through a fairly wide range of soil moisture.

Most areas of this soil are farmed. Many areas are used for corn, soybeans, and small grain. Some areas are used for hay or pasture, and a few areas are in orchards or woodland.

This soil is well suited to corn, soybeans, and small grain. This soil is susceptible to erosion. During extended dry periods, droughtiness is a limitation for shallow-rooted crops. Conservation farming is needed in areas of cultivated crops to help control erosion and surface runoff. Crop rotation, minimum tillage, terraces, diversions, contour farming, grassed waterways, or grade stabilization structures help prevent excessive soil loss. Crop residue management and cover crops help control erosion and improve and maintain tilth and organic matter content.

Grasses and legumes for hay or pasture are effective in controlling soil blowing and water erosion on this soil. Overgrazing or grazing when the soil is too wet causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is well suited to trees. The limitation is moderate for plant competition. Seedlings survive and grow well if competing vegetation is controlled. The control or removal of unwanted trees and shrubs can be accomplished by site preparation or by spraying, cutting, or girdling.

The limitation is slight on this soil for building sites. It is moderate for local roads and streets because of the frost action. Drainage ditches are needed, and the base material needs to be strengthened with a more suitable material if local roads and streets are to function properly.

The limitation is moderate for septic tank absorption fields because of moderate permeability. Increasing the size of the filter field helps overcome this limitation.

This soil is in capability subclass IIe and woodland suitability subclass 1o.

HdC—Hillsdale sandy loam, 6 to 12 percent slopes. This soil is moderately sloping, deep, and well drained. It is on irregularly shaped knolls and ridges on uplands and on narrow breaks along drainageways and depressions. This soil has few to common cobbles on the surface. Areas are generally elongated. They are dominantly about 10 acres but range from 4 to 40 acres.

Typically, the surface layer is dark grayish brown sandy loam about 8 inches thick. The subsurface layer is brown sandy loam about 4 inches thick. The substratum to a depth of 84 inches is yellowish brown sandy loam. In some areas, the depth to the substratum is less than 42 inches, or the subsoil and substratum are finer textured than typical, or pockets and strata of sand and gravel are between the subsoil and substratum.

Included with this soil in mapping are small areas of Wawasee and Martinsville soils on positions similar to this Hillsdale soil, and areas of soils that have slopes of less than 6 percent or more than 12 percent. The included soils make up 5 to 10 percent of this map unit.

Permeability is moderate. Available water capacity and organic matter content are moderate. Surface runoff from cultivated areas is medium. The surface layer is friable and easily tilled through a fairly wide range of soil moisture.

Most areas of this soil are farmed with the adjacent, less sloping Hillsdale soils. Many areas are used for corn, soybeans, and small grain. Some areas are used for hay or pasture, and a few areas are in orchards or woodland.

This soil is suited to corn, soybeans, and small grain if erosion is controlled. Droughtiness is a limitation during seasons of prolonged, low rainfall, particularly when shallow-rooted crops are grown. Conservation farming is needed in areas of cultivated crops to control erosion and surface runoff. Crop rotation, minimum tillage, terraces, diversions, contour farming, grassed waterways, or grade stabilization structures help prevent excessive soil loss. Crop residue management and cover crops help control erosion and improve and maintain tilth and organic matter content.

Grasses and legumes for hay and pasture are well suited to this soil and are effective in controlling soil blowing and water erosion. Overgrazing or grazing when the soil is too wet causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is well suited to trees. The limitation is moderate for plant competition. Seedlings survive and grow well if competing vegetation is controlled. The control or removal of unwanted trees and shrubs can be accomplished by site preparation or by spraying, cutting or girdling.

The limitation is moderate for dwellings with or without basements because of the slope. Sites need to be graded to modify the slope, and the buildings need to be designed to complement the slope. Topsoil should be stockpiled and replaced on disturbed areas. Sites should

be revegetated soon after construction to prevent erosion.

The limitation is moderate for local roads and streets because of the slope and frost action. The roadway needs to be cut and filled to complement the slope. Drainage ditches are needed, and the base material needs to be strengthened with a more suitable material if local roads and streets are to function properly.

The limitation is moderate for septic tank absorption fields because of the slope and moderate permeability. The filter field should be lengthened and graded to modify slope.

This soil is in capability subclass IIIe and woodland suitability subclass 1o.

Ho—Homer sandy loam. This soil is nearly level and somewhat poorly drained. It is on flats in outwash areas. This soil is moderately deep over sand and gravel. Areas are elongated or irregular in shape. They are dominantly about 40 acres but range from 4 to 640 acres.

Typically, the surface layer is dark brown sandy loam about 8 inches thick. The subsoil is about 22 inches thick. It is brown, mottled, firm, sandy clay loam, clay loam, and gravelly clay loam. The substratum to a depth of 60 inches is yellowish brown stratified coarse sand and gravel. The subsoil extends to a depth of 48 inches in a few areas. In some small areas the gray mottles are below a depth of 20 inches.

Included with this soil in mapping are small depressional areas of Sebewa soils and small areas of Brady and Whitaker soils on positions similar to this Homer soil. The included soils make up 5 to 10 percent of this map unit.

Permeability is moderate in the solum and very rapid in the underlying material. Available water capacity and organic matter content are moderate. Surface runoff from cultivated areas is slow. The surface layer is friable and easily tilled through a wide range of soil moisture.

Most areas of this soil are farmed. Many areas are used for corn, soybeans, and small grain. Some areas are used for hay or pasture, and a few areas are in orchards or woodland.

This soil is suited to corn, soybeans, and small grain. Wetness is the major limitation in use and management. If drainage is adequate, a conservation cropping system that includes row crops most of the time is used. Special blinding or filtering material is needed to keep sand from filling tile drains. This soil becomes droughty if the water table is lowered excessively. Minimum tillage, crop residue management, and cover crops help maintain organic matter and good tilth.

Grasses and legumes for hay or pasture are well suited to this soil. Deep-rooted legumes such as alfalfa are not as well suited as shallow-rooted legumes. Where this soil is used for pasture, the major concerns in management are overgrazing and grazing when wet. Grazing when wet causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is suited to trees. The limitation is moderate for plant competition and use of equipment. Water-tolerant species are favored in timber stands. Seedlings survive and grow well when competing vegetation is controlled. The control or removal of unwanted trees and shrubs can be accomplished by site preparation or by spraying, cutting, or girdling.

The limitation is severe on this soil for building sites because of the wetness. If an adequate drainage system in combination with storm sewers is installed, the water table can be lowered.

The limitation is severe for local roads and streets because of the frost action and low strength. Proper drainage of the roadway and strengthening the base with more suitable material help overcome these limitations.

The limitation is severe for septic tank absorption fields because of the wetness caused by the seasonal high water table and because of the poor filtering quality of this soil. These limitations can possibly be overcome by use of the mound system or aerator system. Contamination of ground water supplies is possible in some areas.

This soil is in capability subclass IIw and woodland suitability subclass 3o.

Ht—Houghton muck. This soil is nearly level, deep, and very poorly drained. It is in depressional areas on uplands and outwash plains. Surface runoff from adjacent, higher lying areas frequently ponds on this soil. Areas are generally round or elongated in shape. They are dominantly about 20 acres but range from 3 to 80 acres.

Typically, the surface layer is black muck about 9 inches thick. Beneath this to a depth of about 60 inches is layers of black and dark reddish brown organic material. Around the edge of most areas is a narrow strip in which the muck is less than 50 inches thick. In some small areas, less than 50 inches of organic soil is over sandy or loamy mineral material or marl, or a thin layer of brown peat is below the surface layer, or partially decomposed logs and tree branches are in the muck layer. Some areas have concentrations of bog iron on the surface or throughout the profile. These areas can be identified by their dark red or yellowish red color.

Included with this soil in mapping is a narrow strip of a very poorly drained mineral soil around many areas. The included soil makes up 2 to 5 percent of this map unit.

Permeability is moderately slow to moderately rapid. Available water capacity and organic matter content are very high. Surface runoff is very slow. The seasonal high water table is at the surface, or water is ponded on the surface.

Very few areas of this soil are farmed. Most of the areas that are not drained are used for wetland wildlife habitat, but some are used for permanent pasture. The natural permanent vegetation on this soil provides good

habitat for wildlife. Wildlife benefit from the abundance of protective cover and from the seed-bearing woody shrubs.

If this soil is drained, it is suited to corn, soybeans, and special crops. The wetness is a serious limitation. Drainage can increase the hazard of oxidation and subsidence of the organic material. Fire is a hazard when the organic material is dry, because the muck will burn. Drainage outlets are generally not available if the water level of adjacent lakes and streams is the same as the water table in this soil. Excessive water can be removed in places by open ditches, tile drains, or surface drains, but generally pumping is required.

In places, the undrained areas of this soil are suited to pasture. The natural vegetation is sedges, cattails, and water-tolerant grasses, trees, and shrubs. Since most areas are depressional and do not have drainage outlets, drainage commonly is not feasible. Reed canarygrass is well suited to pasture on these soils.

This soil is poorly suited to trees, however, water-tolerant hardwoods commonly are around the perimeter of soil areas. The limitation is severe for plant competition, seedling mortality, and use of equipment. The windthrow hazard is severe. Water-tolerant species are favored in timber stands. The control and removal of unwanted trees and shrubs can be accomplished by site preparation or by spraying, cutting, and girdling.

The limitation is severe for building sites because of the ponding and low strength. Most areas are difficult to drain because this soil is commonly in the lowest lying part of the landscape. Pumping is the only suitable means of draining some areas. The muck is very unstable for building purposes, and piling is necessary in places.

The limitation is severe for local roads and streets because of the ponding and low strength. Excavating the muck to underlying mineral soil and replacing it with a more suitable base material in conjunction with elevating the roadbed help overcome these limitations.

The limitation is severe for septic tank absorption fields because of the ponding. Commercial sewers are needed.

This soil is in capability subclass Vw and woodland suitability subclass 4w.

Hw—Houghton muck, drained. This soil is nearly level, deep, and very poorly drained. It is in depressional areas on uplands and outwash plains. Surface runoff from adjacent, higher lying areas frequently ponds on this soil. Areas are generally elongated and irregular in shape. They are dominantly about 20 acres but range from 3 to 50 acres.

Typically, the surface layer is black muck about 9 inches thick. Beneath this to a depth of about 60 inches are layers of black and dark reddish brown organic material. Around the edge of most areas is a narrow strip in which the muck is less than 50 inches thick. In some small areas, less than 50 inches of organic soil is over sandy or loamy mineral material or marl, or a brownish peat layer is below the surface layer, or partially decomposed logs and tree branches are in the lower part of the muck. Undrained areas 1/2 acre to 2 acres in size are in some places, and in some places the organic material is strongly acid. Some areas have concentrations of bog iron on the surface or throughout the profile. These areas can be identified by their dark red or yellowish red color.

Included with this soil in mapping is a narrow strip of a very poorly drained mineral soil around many areas. Also included are areas of Wallkill soils around the edges of the depressions where loamy mineral soil from eroding areas has been deposited over the muck. The included soils make up 2 to 5 percent of this map unit.

Permeability is moderately slow to moderately rapid. Available water capacity and organic matter content are very high. Surface runoff is very slow. The seasonal high water table is at the surface, or water is ponded on the surface.

Most areas of this soil are farmed. Areas are used for corn, soybeans, special crops, and pasture. The major crops are corn and soybeans.

This soil is suited to corn, soybeans, sweet corn, mint, onions, and potatoes. Strongly acid areas are suited to blueberries. Wetness is the main limitation to cultivated crops. The rooting depth is shallow because of the high water table. Soil blowing is a hazard when the soil is dry or void of vegetative cover. Overdrainage can cause excessive subsidence. Fire is a hazard when the organic material is dry, because the muck will burn. Minimum tillage and crop residue management help improve and maintain tilth.

Grasses for hay and pasture are well suited to this soil. This soil is poorly suited to deep-rooted legumes such as alfalfa because of the wetness. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the soil in good condition.

This soil is poorly suited to trees, however, water-tolerant hardwoods are commonly around the perimeter of soil areas. The limitation is severe for plant competition, seedling mortality, and use of equipment. The windthrow hazard is severe. Water-tolerant species are favored in timber stands. The control and removal of unwanted trees and shrubs can be accomplished by site preparation or by spraying, cutting, and girdling.

The limitation is severe for building sites because of the ponding and low strength. Most areas are difficult to drain because this soil is commonly in the lowest lying part of the landscape. Pumping is the only suitable means of draining some areas. The muck is very unstable for building purposes, and piling is necessary in places.

The limitation is severe for local roads and streets because of the ponding, high potential frost action, and low strength. Excavating the muck to an underlying min-

eral soil and elevating the roadbed help overcome these limitations.

The limitation is severe for septic tank absorption fields because of the seasonal high water table and frequent ponding. Commercial sewers are generally needed.

This soil is in capability subclass IIIw and woodland suitability subclass 4w.

Hx—Houghton muck, ponded. This soil is nearly level, deep, and very poorly drained. It is covered by shallow water much of the time. This soil is adjacent to large bodies of deep water, namely lakes, streams, and rivers, and in depressions that are not drained. Areas are generally elongated and irregular in shape. They are dominantly about 20 acres but range from 3 to 160 acres.

Typically, the soil is black muck that is more than 50 inches thick.

Included with this soil in mapping are small areas of soils that have peat, silt, clay, or sand and gravel beneath a thin layer of muck and areas of soils that have less than 50 inches of organic material and are underlain with marl, loamy material, or sandy material. The included soils make up 5 to 10 percent of this map unit.

Permeability is moderately slow to moderately rapid. Available water capacity and organic matter content are very high. Surface runoff from higher lying areas ponds on this soil. The seasonal high water table is at or above the surface. In a few areas, the water table is a few inches below the surface for short periods late in summer.

This soil is not suitable for cropland, pastureland, or woodland. It is suited to wildlife habitat (fig. 5) and is important for this use. The vegetation consists of cattails, reeds, sedges, marsh grasses, buttonbush, red ozier dogwood, willows, and soft maple or other water-tolerant shrubs and trees. The natural vegetation provides good habitat for wildlife. It furnishes abundant protective cover and sufficient available food from the seed-bearing woody shrubs.

Areas of this soil are not suited for building sites or sanitary facilities, because it is not economically feasible to overcome the ponding.

This soil is in capability subclass VIIIw and woodland suitability subclass 4w.

MbB—Martinsville sandy loam, 1 to 6 percent slopes. This soil is gently sloping, deep, and well drained. It is on irregularly shaped knolls and narrow, elongated breaks along drainageways on outwash plains and uplands. Areas are irregular in shape. They are dominantly about 10 acres but range from 4 to 40 acres.

Typically, the surface layer is dark grayish brown sandy loam about 9 inches thick. The subsoil is about 49 inches thick. The upper part of the subsoil is dark yellowish brown, friable loam and sandy clay loam and the lower part is dark yellowish brown, friable loam. The substratum to a depth of 74 inches is yellowish brown, stratified loam, fine sandy loam, fine sand, and silts. In small eroded areas on steeper slopes a part of the subsoil has been mixed with the surface layer by plowing.

Included with this soil in mapping are a few small areas of soils that have slopes of more than 6 percent and a few small areas of Hillsdale, Metea, and Wawasee soils on positions similar to this Martinsville soil. Small areas of Whitaker soils are in narrow drainageways. The included soils make up 5 to 10 percent of this map unit.

Permeability is moderate. Available water capacity and organic matter content are moderate. Surface runoff from cultivated areas is medium. The surface layer is friable and easily tilled through a fairly wide range of soil moisture.

Most areas of this soil are farmed. Many areas are used for corn, soybeans, and small grain. Some areas are used for hay or pasture, and a few areas are in orchards or woodland.

This soil is well suited to corn, soybeans, and small grain. Erosion is a hazard, and droughtiness is a limitation for shallow-rooted crops during extended dry periods. Conservation management is needed in cultivated areas to help control erosion and surface runoff. Crop rotation, minimum tillage, terraces, diversions, contour farming, grassed waterways, or grade stabilization structures help prevent excessive soil loss. Crop residue and cover crops help control erosion and improve and maintain tilth and organic matter content.

Grasses and legumes for hay or pasture in the cropping system is effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is well suited to trees. The limitation is moderate for plant competition. Seedlings survive and grow well if competing vegetation is controlled. The control or removal of unwanted trees and shrubs can be accomplished by site preparation or by spraying, cutting, or girdling.

The limitation is moderate in this soil for dwellings with or without basements because of the shrink-swell potential and the low strength. Foundations and footings should be designed to prevent structural damage caused by shrinking and swelling. Placing drain tile around foundations and backfilling along the foundation wall with sand and gravel help overcome these limitations. The site needs to be graded to modify the slope, and the buildings need to be designed to complement the slope.

The limitation is severe for local roads and streets because of the low strength and frost action. Drainage ditches are needed, and the base material needs to be strengthened with a more suitable material if streets and roads are to function properly.

Figure 5.—A water control or stoplog structure used to raise and lower water on a waterfowl area in Houghton muck, ponded.

The limitation is slight for septic tank absorption fields.

This soil is in capability subclass IIe and woodland suitability subclass 1o.

Mc—Martisco muck. This soil is nearly level and very poorly drained. It is in depressional areas, commonly near lakes. This soil consists of shallow organic material over marl. Surface runoff from adjacent, higher lying areas frequently ponds on this soil. Areas are irregular in shape. They are dominantly about 20 acres but range from 4 to 80 acres.

Typically, the surface layer is black muck about 10 inches thick. Beneath this to a depth of about 60 inches is light brownish gray and light gray marl.

Included with this soil in mapping are small areas of soils that have an organic layer more than 16 inches thick over marl, small areas of Adrian and Palms soils, and areas of soils that have marl at the surface. The included soils make up 5 to 10 percent of this map unit.

Permeability is moderate or moderately rapid in the organic material and slow in the marl. Available water capacity is very high. Organic matter content in the surface layer is very high. Surface runoff is very slow or

ponded. The seasonal high water table is at or above the surface.

Very few areas of this soil are farmed. Most undrained areas are used for wetland wildlife habitat, but some are used for permanent pasture. The natural permanent vegetation on this soil provides good habitat for wildlife. Wildlife benefit from the abundance of protective cover and from the seed-bearing woody shrubs. The natural vegetation generally is water-tolerant grasses, sedges, reeds, and woody brush.

Where this soil is used for cultivated crops, special crops such as onions, potatoes, and cabbage can be grown. Shallow-rooted crops are better suited than deep-rooted crops. The thickness of the organic surface layer greatly influences productivity. To prolong the productivity of this soil, mixing the marl with the surface layer should be avoided. Excessive water is difficult to remove because of the high water level of adjacent lakes. Open ditches can be used to drain the areas where outlets are available. Tile generally does not work well in the marl.

Where drained, areas of this soil are suited to pasture. Most depressional areas, however, do not have drainage outlets and drainage is not feasible. Reed canarygrass is well suited to pasture on this soil.

This soil is poorly suited to trees. The hazards of windthrow and seedling mortality are severe and the use of equipment is limited. Water-tolerant species are favored in timber stands. The control and removal of unwanted trees and shrubs can be accomplished by site preparation or by spraying, cutting, and girdling.

The limitation is severe on this soil for building sites because of the ponding. Drainage is difficult in most areas because this soil is commonly in the lowest lying part of the landscape. Pumping is the only suitable means of draining in some areas. The muck is very unstable for building purposes, and the marl is variable. Piling is needed in places in some areas of this soil.

The limitation is severe for local roads and streets because of the ponding. Excavating the muck and marl to an underlying mineral soil and replacing it with a more suitable base material in conjunction with elevating the roadbed help to overcome this limitation.

The limitation is severe for septic tank absorption fields because of the slow permeability and frequent ponding. Commercial sewers are needed.

This soil is in capability subclass IVw and woodland suitability subclass 5w.

MeB—Metea loamy sand, 2 to 6 percent slopes. This soil is gently sloping, deep, and well drained. It is on knolls on uplands. This soil has few to common cobbles on the surface. Areas are irregular in shape. They are dominantly about 20 acres but range from 5 to 160 acres.

Typically, the surface layer is dark brown loamy sand about 9 inches thick. The subsoil is about 49 inches thick. The upper part of the subsoil is yellowish brown and dark yellowish brown, friable loamy sand, and the lower part is dark yellowish brown, friable sandy loam and firm clay loam. The substratum to a depth of 72 inches is yellowish brown loam. In small areas, the loamy sand layers combined are more than 40 inches thick.

Included with this soil in mapping are small areas of Chelsea, Plainfield, Wawasee, and Hillsdale soils on positions similar to this Metea soil. Also included are small areas of soils that have slopes of 1 or 2 percent on top of knolls and ridges, a few narrow, elongated areas of soils that have slopes of 6 to 12 percent, and narrow, elongated areas of Conover soils in drainageways. The included soils make up 8 to 14 percent of this map unit.

Permeability is very rapid in the loamy sand upper layers and moderate in the lower part of the profile. Available water capacity is moderate. Organic matter content is low. Surface runoff from cultivated areas is slow. The surface layer is friable and easily tilled through a fairly wide range of soil moisture.

Most areas of this soil are farmed. Many areas are used for corn, soybeans, and small grain. Some areas are used for hay or pasture, and a few areas are used for orchards or woodland.

This soil is well suited to corn, soybeans, and small grain. It is susceptible to erosion. Droughtiness is a limitation for shallow-rooted crops during extended dry periods. In cultivated cropland, conservation measures are needed to help control erosion and surface runoff. Crop rotation, minimum tillage, terraces, diversions, contour farming, grassed waterways, or grade stabilization structures help prevent excessive soil loss. Crop residue management and cover crops help control erosion and improve and maintain tilth and organic matter content.

Grasses and legumes for hay or pasture are suited to this soil. They are effective in controlling soil blowing and water erosion. Overgrazing causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, and timely deferment of grazing help keep the pasture and soil in good condition.

This soil is well suited to trees. Seedlings survive and grow well if competing vegetation is controlled. The control or removal of unwanted trees and shrubs can be accomplished by site preparation or by spraying, cutting, or girdling.

The limitation is slight on this soil for dwellings with or without basements.

The limitation is moderate for local roads and streets because of the frost action. Drainage ditches are needed, and the base material needs to be strengthened with a more suitable material if roads and streets are to function properly.

The limitation is moderate for septic tank absorption fields because of the moderate permeability in the underlying till. Increasing the length of the absorption field helps overcome this limitation.

This soil is in capability subclass IIIe and woodland suitability subclass 2s.

MeC—Metea loamy sand, 6 to 12 percent slopes. This soil is moderately sloping, deep, and well drained. It is on knolls and narrow ridges on uplands. Commonly, this soil has gravel and a few stones on the surface and mixed throughout the profile. Areas are irregular in shape. They are dominantly about 10 acres but range from 3 to 40 acres.

Typically, the surface layer is dark grayish brown loamy sand about 8 inches thick. The subsoil is about 32 inches thick. The upper part of the subsoil is yellowish brown, very friable loamy sand, and the lower part is brown and yellowish brown, firm clay loam. The substratum to a depth of 60 inches is yellowish brown loam till. In a few small areas, the combined layers of loamy sand are more than 40 inches thick.

Included with this soil in mapping are small areas of Chelsea, Plainfield, Wawasee, and Hillsdale soils on positions similar to this Metea soil. Also included are small areas of soils that have slopes of less than 6 percent or more than 12 percent. The included soils make up 8 to 14 percent of this map unit.

Permeability is very rapid in the loamy sand upper layers and moderate in the lower part of the profile. Available water capacity and organic matter content are moderate. Surface runoff from cultivated areas is medium. The surface layer is friable and easily tilled through a fairly wide range of soil moisture.

Most areas of this soil are farmed along with the adjacent, less sloping Metea soils. Many areas are used for corn, soybeans, and small grain. Some areas are used for hay or pasture, and a few areas are in orchards or woodland.

If erosion is controlled, this soil is suited to corn, soybeans, and small grain. Droughtiness is a limitation during seasons of prolonged, low rainfall, particularly to shallow-rooted crops. In cultivated cropland, conservation measures are needed to help control erosion and surface runoff. Crop rotation, minimum tillage, terraces, diversions, contour farming, grassed waterways, or grade stabilization structures help prevent excessive soil loss. Crop residue management and cover crops help control erosion and improve and maintain tilth and organic matter content.

Grasses and legumes for hay and pasture are well suited to this soil and are effective in controlling soil blowing and water erosion. Overgrazing causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, and timely deferment of grazing help keep the pasture and soil in good condition.

This soil is well suited to trees. The limitation is moderate for seedling mortality. Seedlings survive and grow well if competing vegetation is controlled. The control or removal of unwanted trees and shrubs can be accomplished by site preparation or by spraying, cutting or girdling.

The limitation is moderate on this soil for dwellings with or without basements because of the slope. Designing the building to conform to the slope or filling and leveling the site helps overcome the limitation.

The limitation is moderate for local roads and streets because of the slope and frost action. Drainage ditches are needed to remove the excess water and help reduce the frost action. The roadway needs to be cut and filled and designed to complement the slope.

The limitation is moderate for septic tank absorption fields because of the slope and because of moderate permeability in the underlying till. Increasing the size of the absorption field helps overcome the moderate permeability. The filter field needs to be graded to modify the slope.

This soil is in capability subclass IIIe and woodland suitability subclass 2s.

MoB2—Morley loam, 2 to 6 percent slopes, eroded. This soil is gently sloping, deep, and well drained. It is on undulating till plains and moraines on uplands. Areas are irregular in shape. They are dominantly about 20 acres but range from 5 to 80 acres.

Typically, the surface layer is dark grayish brown loam about 7 inches thick. The subsoil is about 19 inches thick. The upper part of the subsoil is yellowish brown silty clay loam, and the lower part is mottled, brown clay. The underlying material to a depth of 60 inches is brown clay loam. In some areas, the surface layer is sandy loam or silty clay loam.

Included with this soil in mapping are narrow, elongated areas of Blount soils in drainageways and small areas of Rawson soils. The included soils make up 5 to 10 percent of this map unit.

Permeability is slow. Available water capacity and organic matter content are moderate. Surface runoff from cultivated areas is rapid. The surface layer is friable and easily tilled through a wide range of soil moisture.

Most areas of this soil are farmed. Corn, soybeans, and small grain are major crops. Some areas are used for hay or pasture, and a few areas are used for woodland.

This soil is well suited to corn, soybeans, and small grain. In cultivated cropland, conservation measures are needed to control erosion and surface runoff. Crop rotation, minimum tillage, diversions, contour farming, grassed waterways, or grade stabilization structures help to prevent excessive soil loss. Crop residue management, cover crops, and green manure crops help control erosion and improve and maintain tilth and organic matter content.

Grasses and legumes for hay and pasture are well suited to this soil and are very effective in controlling erosion and surface runoff. When this soil is grazed under wet conditions, the surface layer is compacted, surface runoff is increased, and poor tilth results. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is well suited to trees. The limitation is moderate for plant competition. Seedlings survive and grow well if competing vegetation is controlled. The control or

removal of unwanted trees and shrubs can be accomplished by site preparation or by spraying cutting or girdling.

The limitation is moderate on this soil for building sites because of the shrink-swell potential. Foundations and footings should be designed to prevent structural damage caused by shrinking and swelling of this soil. Placing drain tile around foundations and backfilling along the foundation wall with sand and gravel help overcome the limitation.

The limitation is severe for local roads and streets because of the low strength. This limitation can probably be overcome by mixing the soil with another soil of coarser texture or by using a more suitable base material, such as sand and gravel.

The limitation is severe for septic tank absorption fields because of the slow permeability and wetness. Increasing the size of the absorption field and providing adequate drainage help to overcome these limitations.

This soil is in capability subclass IIe and woodland suitability subclass 2o.

MoC2—Morley loam, 6 to 14 percent slopes, eroded. This soil is moderately sloping and strongly sloping. It is deep, and well drained. It is on narrow, elongated breaks along drainageways or depressions and on irregularly shaped knolls on uplands and moraines. Areas are irregular in shape and range from 5 to 15 acres.

Typically, the surface layer is dark grayish brown loam about 6 inches thick. The subsoil is about 26 inches thick. The upper part of the subsoil is yellowish brown and brown clay loam and clay, and the lower part is mottled, brown clay loam. The underlying material to a depth of 60 inches is brown clay loam. In a few areas, the surface layer is sandy loam or silty clay loam.

Included with this soil in mapping are some severely eroded areas, 1/2 acre to 2 acres in size, that have a plow layer of yellowish brown silty clay loam. The included soils make up 5 to 10 percent of this map unit.

Permeability is slow. Available water capacity and organic matter content are moderate. Surface runoff from cultivated areas is rapid. The surface layer is friable and easily tilled through a wide range of soil moisture.

Some areas of this soil are farmed. Corn, soybeans, small grain, and hay and pasture are the main crops. Some areas are in woodland.

This soil is suited to corn, soybeans, and small grain. Where this soil is used for cultivated crops, the hazard of erosion is severe. Crop rotations, minimum tillage, terraces, diversions, contour farming, grassed waterways, and grade stabilization structures are needed to help control erosion and surface runoff and help prevent excessive soil loss. Returning crop residue to this soil and including cover crops in the cropping system help reduce runoff, control erosion and maintain tilth and organic matter content.

Grasses and legumes for hay or pasture are well suited to this soil and are effective in controlling soil blowing and water erosion. Overgrazing or grazing when the soil is too wet causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is well suited to trees. Seedlings survive and grow well if competing vegetation is controlled. The control or removal of unwanted trees and shrubs can be accomplished by site preparation or by spraying, cutting, or girdling.

The limitation is moderate on this soil for dwellings because of the shrink-swell potential and slope. Grading the site to modify the slope or designing the building to complement the slope helps overcome slope as a limitation. To help overcome the effects of shrinking and swelling of the soil, foundations and footings should be designed to prevent structural damage. Placing drain tile around foundations and backfilling along the foundation wall with sand and gravel also help overcome the shrinking and swelling.

The limitation is severe for local roads and streets because of the low strength. Mixing the soil with another soil of coarser texture or using a more suitable base material, such as sand and gravel, helps overcome this limitation.

The limitation is severe for septic tank absorption fields because of the wetness and slow permeability. Increasing the size of the absorption field and providing adequate drainage help overcome these limitations.

This soil is in capability subclass IIIe and woodland suitability subclass 2o.

NaA—Nappanee silt loam, 0 to 3 percent slopes. This soil is nearly level and gently sloping, deep, and somewhat poorly drained. It is on flat till plains. Areas are broad and generally range from 10 to 20 acres; however, one area is about 1,000 acres.

Typically, the surface layer is dark grayish brown silt loam about 8 inches thick. The subsurface layer is light brownish gray silt loam about 3 inches thick. The subsoil is about 21 inches thick. The upper part of the subsoil is brown, mottled, firm clay, and the lower part is grayish brown, mottled, very firm clay. The substratum to a depth of 60 inches is light brownish gray clay.

Included with this soil in mapping are small areas of Blount and Haskins soils on positions similar to this Nappanee soil. Also included are small areas of Pewamo soils in pockets and drainageways and areas of soils that are less than 2 acres in size and are too wet for crops. The included soils make up 5 to 10 percent of this map unit.

Permeability is slow. Available water capacity is moderate. Organic matter content is moderate in the surface layer. Surface runoff is very slow. This soil has a seasonal high water table at a depth of 1 foot to 2 feet. The surface layer is friable and is easy to till under proper moisture conditions.

Some areas of this soil are farmed. Most areas are used for pasture. Some areas are used for corn, soybeans, small grain, or hay. A few areas are in woodland.

If this soil is adequately drained, it is suited to corn, soybeans, and small grain. Wetness is the main limitation that affects use and management. Where drainage is adequate and fertility is maintained, a conservation cropping system that includes row crops most of the time can be used. Large ditches in many areas of this soil help control wetness. Blinding tile with selected materials improves the efficiency of the drainage system. Tile spacing needs to be much closer than for average placement of tile because of the high clay content of this soil. Minimum tillage and crop residue management help improve and maintain tilth and organic matter content.

This soil is well suited to grasses and legumes for hay or pasture. The heaving of deep-rooted legumes is a problem in some years. Drainage of this soil is necessary to obtain high yields for forage or pasture. Overgrazing or grazing when this soil is too wet causes surface compaction and poor tilth and reduces the infiltration rate of water. Overgrazing also reduces the plant density and plant hardiness. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help reduce surface compaction and maintain good tilth and plant densities.

This soil is suited to trees. The limitation is moderate for use of equipment. Water-tolerant species are favored in timber stands. Seedling mortality and the windthrow hazard are severe. Some replanting of seedlings is needed in places to obtain adequate stands. Plant competition is moderate. Seedlings survive and grow well if competing vegetation is controlled. The control or removal of unwanted trees and shrubs can be accomplished by site preparation or by spraying, cutting, or girdling.

The limitation for building sites is severe on this soil because of the seasonal high water table and shrink-swell. Draining this soil is difficult because of the high percentage of clay. However, if an adequate drainage system in combination with storm sewers is installed, the water table can be lowered. Foundations and footings should be designed to prevent structural damage caused by the shrinking and swelling of this soil. Placing drain tile around foundations and backfilling along the foundation wall with sand and gravel help overcome the limitations.

The limitation is severe for local roads and streets because of the low strength and shrinking and swelling of the soil. Drainage ditches are needed, and the base material needs to be strengthened with a more suitable material if roads and streets are to function properly.

The limitation is severe for septic tank absorption fields because of the high water table and very slow permeability. Draining the area, increasing the size of the absorption field, and installing perimeter drains around the filter field help overcome these limitations.

This soil is in capability subclass IIIw and woodland suitability subclass 3c.

OsA—Oshtemo loamy sand, 0 to 2 percent slopes. This soil is nearly level, deep, and well drained. It is on broad outwash plains and along major drainageways. This soil has few to common cobbles on the surface. Areas are broad and irregular in shape. They are dominantly about 20 acres but range from 5 to 640 acres.

Typically, the surface layer is very dark grayish brown loamy sand about 9 inches thick. The subsoil is about 44 inches thick. The upper part of the subsoil is dark yellowish brown and brown, friable sandy loam; the next part is brown, firm gravelly sandy clay loam; and the lower part is brown and dark reddish brown, friable sandy loam. The substratum to a depth of 60 inches is brown sand and gravelly sand.

Included with this soil in mapping are small areas of Boyer, Chelsea, and Hillsdale soils on positions similar to this Oshtemo soil and small areas of Brady and Bronson soils on lower lying positions. Also included are small areas of soils that have slopes of 2 to 6 percent, areas of soils 1/2 acre to 2 acres in size that have a surface layer of very gravelly loamy sand, and small areas of soils in which the loamy sand layer is 20 to 30 inches thick. The included soils make up 8 to 15 percent of this map unit.

Permeability is moderately rapid in the subsoil and very rapid in the underlying material. Available water capacity and organic matter content are moderate. Surface runoff from cultivated areas is slow. The seasonal high water table is below a depth of 6 feet. The surface layer is friable and easily tilled through a fairly wide range of soil moisture.

Most areas of this soil are farmed. Many areas are used for corn, soybeans, and small grain. Some areas are used for hay or pasture, and a few areas are in orchards or woodland.

This soil is well suited to corn, soybeans, and small grain. Droughtiness is the main limitation on this soil, and soil blowing is a hazard. Well distributed rainfall, particularly during midseason, is essential for good productivity. This soil is well suited to irrigation, and crop yields can be significantly increased with supplemental water. This soil has slightly higher production potential than the Oshtemo soils that have 2 to 6 percent slopes. This is because more water is available to plants and the hazard of erosion is less. Farm machinery can easily travel over this nearly level soil, thus saving energy. Minimum tillage and crop residue management help improve and maintain tilth and organic matter content.

Grasses and legumes for hay or pasture are well suited to this soil. Well distributed rainfall increases yields of forage or pasture. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Overgrazing also reduces the plant density and plant hardiness. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help reduce surface compaction and maintain good tilth and plant densities.

This soil is well suited to trees. Seedlings survive and grow well if competing vegetation is controlled. The con-

trol or removal of unwanted trees and shrubs can be accomplished by site preparation or by spraying, cutting, or girdling.

The limitation is slight on this soil for building sites and for local roads and streets. The limitation is severe for septic tank absorption fields because the filtering quality of this soil is poor. Ground water contamination is possible in some areas because of the moderately rapid permeability.

This soil is in capability subclass IIIs and woodland suitability subclass 3s.

OsB—Oshtemo loamy sand, 2 to 6 percent slopes. This soil is gently sloping, deep and well drained. It is on irregularly shaped knolls and ridges and narrow breaks along drainageways and in potholes on outwash plains. This soil has few to common cobbles on the surface. Areas are broad and irregular in shape. They are dominantly about 20 acres but range from 5 to 160 acres.

Typically, the surface layer is dark grayish brown loamy sand about 8 inches thick. The subsurface layer is brown sandy loam about 4 inches thick. The subsoil is about 40 inches thick. The upper part of the subsoil is brown and dark brown sandy loam, and the lower part is dark brown sandy loam and loamy sand. The substratum to a depth of 60 inches is grayish brown, stratified coarse sand and fine gravelly sand.

Included with this soil in mapping are small areas of Boyer, Chelsea, and Hillsdale soils on positions similar to this Oshtemo soil and small areas of Brady soils on lower lying positions and in drainageways. Also included are areas of soils that have slopes of less than 2 percent or slopes of 6 to 12 percent, areas of soils 1/2 acre to 2 acres in size that have a surface layer of very gravelly loamy sand, and small areas of soils in which the loamy sand layer is 20 to 30 inches thick. The included soils make up 8 to 15 percent of this map unit.

Permeability is moderately rapid in the subsoil and very rapid in the underlying material. Available water capacity and organic matter content are moderate. Surface runoff from cultivated areas is slow. The seasonal high water table is below a depth of 6 feet. The surface layer is friable and easily tilled through a fairly wide range of soil moisture.

Most areas of this soil are farmed. Many areas are used for corn, soybeans, and small grain. Some areas are used for hay or pasture, and a few areas are in woodland.

This soil is suited to corn, soybeans, and small grain. Droughtiness is a limitation on this soil, and erosion and soil blowing are hazards. Well distributed rainfall particularly during midseason, is essential for good productivity. This soil is well suited to irrigation, and crop yields can be significantly increased with supplemental water. Minimum tillage and crop residue management help improve and maintain tilth and organic matter content.

Grasses and legumes for hay or pasture are well suited to this soil and are effective in controlling soil blowing and water erosion. Well distributed rainfall increases yields of forage or pasture. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Overgrazing also reduces the plant density and plant hardiness. Proper stocking rates, rotation grazing, timely deferment of grazing, and restricted use during wet periods help reduce surface compaction and maintain good tilth and plant densities.

This soil is well suited to trees (fig. 6). Seedlings survive and grow well if competing vegetation is controlled. The control or removal of unwanted trees and shrubs can be accomplished by site preparation or by spraying, cutting, or girdling.

The limitation is slight on this soil for dwellings and for local roads and streets. The limitation is severe for septic tank absorption fields because the filtering quality of this soil is poor. Ground water contamination is possible in some areas because of the moderately rapid permeability.

This soil is in capability subclass IIIs and woodland suitability subclass 3s.

OsC—Oshtemo loamy sand, 6 to 12 percent slopes. This soil is moderately sloping, deep, and well drained. It is on irregularly shaped knolls and ridges on uplands and on breaks along drainageways and depressions on outwash plains. This soil has few to common cobbles on the surface. Areas are irregular in shape. They are dominantly about 10 acres but range from 3 to 40 acres.

Typically the surface layer is dark grayish brown loamy sand about 7 inches thick. The subsoil is about 40 inches thick. The upper part of the subsoil is brown and dark brown sandy loam, and the lower part is dark brown sandy loam and loamy sand. The substratum to a depth of 60 inches is grayish brown, stratified coarse sand and fine gravelly sand. Some areas are moderately eroded and have a lighter colored surface layer that consists of a mixture of the topsoil and brown upper part of the subsoil.

Included with this soil in mapping are small areas of Boyer, Chelsea, and Hillsdale soils on positions similar to this Oshtemo soil and small areas of soils that have slopes of less than 6 percent or have slopes of 12 to 18 percent. Also included are areas of soils 1/2 acre to 2 acres in size that have a surface layer of very gravelly loamy sand and small areas of soils in which the loamy sand layer is 20 to 30 inches thick. The included soils make up 8 to 15 percent of this map unit.

Permeability is moderately rapid. Available water capacity and organic matter content are moderate. Surface runoff from cultivated areas is medium. The seasonal high water table is below a depth of 6 feet. The surface layer is friable and easily tilled through a fairly wide range of soil moisture.

Some areas of this soil are farmed. Corn, soybeans, small grain, and hay and pasture are the main crops. Some areas are in woodland or orchards.

Figure 6.—Young apple orchard on Oshtemo loamy sand, 2 to 6 percent slopes.

This soil is suited to corn, soybeans, and small grain. Droughtiness is a limitation on this soil, and erosion is a hazard. Slope is a limitation for irrigation. Well distributed rainfall, particularly during midsummer, is essential for good productivity. Minimum tillage and crop residue management help improve and maintain tilth and organic matter content.

Grasses and legumes for hay or pasture are well suited to this soil and are effective in controlling soil blowing and water erosion. Well distributed rainfall increases yields of forage or pasture. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Overgrazing also reduces the plant density and plant hardiness. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help reduce surface compaction and maintain good tilth and plant densities.

This soil is well suited to trees. Seedlings survive and grow well if competing vegetation is controlled. The control or removal of unwanted trees and shrubs can be accomplished by site preparation or by spraying, cutting, or girdling.

The limitation is moderate on this soil for dwellings with or without basements because of the slope. Sites should be graded to modify the slope and buildings should be designed to complement slope. Topsoil should be stockpiled and replaced on disturbed areas. Building sites should be revegetated soon after construction to prevent erosion.

The limitation is moderate for local roads and streets because of the slope. Roads should be cut and filled or designed to complement the slope.

The limitation is severe for septic tank absorption fields because of the poor filtering quality of the soil. The filter field should be graded to modify slope. Ground water contamination is possible in some areas because of the moderately rapid permeability.

This soil is in capability subclass IIIe and woodland suitability subclass 3s.

OsD—Oshtemo loamy sand, 12 to 18 percent slopes. This soil is strongly sloping, deep, and well

drained. It is on narrow breaks along drainageways or streams on outwash plains and on knolls and hills on uplands. This soil has few to common cobbles on the surface. Areas are irregular in shape. They are dominantly about 10 acres but range from 3 to 40 acres.

Typically, the surface layer is brown loamy sand about 7 inches thick. The subsoil is about 38 inches thick. The upper part of the subsoil is brown and dark brown sandy loam, and the lower part is dark brown sandy loam and loamy sand. The substratum to a depth of 60 inches is grayish brown, stratified coarse sand and fine gravelly sand. Some areas are moderately eroded and have a surface layer that consists of a mixture of the topsoil and upper part of the subsoil.

Included with this soil in mapping are small areas of Boyer soils on positions similar to this Oshtemo soil and small areas of soils that are mostly sand or have a substratum of loamy sand or sandy loam till. Also included are small areas of soils that have slopes of less than than 12 percent or have slopes of 18 to 25 percent, areas of soils 1/2 acre to 2 acres in size that have a surface layer of very gravelly loamy sand, and severely eroded areas of soils. The included soils make up 5 to 10 percent of this map unit.

Permeability is moderately rapid. Available water capacity and organic matter content are moderate. Surface runoff from cultivated areas is very rapid. The seasonal high water table is below a depth of 6 feet. The surface layer is friable and easily tilled through a fairly wide range of soil moisture.

Most areas of this soil are used for hay and pasture. Some areas are in woodland.

This soil is poorly suited to corn, soybeans, and small grain because of the hazard of erosion. Most row crops are grown so that stands of grasses and legumes can be reestablished. Droughtiness is a limitation on this soil. Slope is a severe limitation to irrigation, and tillage operations are difficult because of the slope. Conservation measures are needed in cultivated areas to help control erosion and surface runoff. Minimum tillage, diversions, grassed waterways, and returning crop residue to this soil help prevent excessive soil loss. A cropping system that includes grasses and legumes for hay and pasture most of the time are effective in reducing runoff and controlling erosion.

Grasses and legumes for hay and pasture are well suited to this soil and are effective in controlling soil blowing and water erosion. Haying operations are difficult because of the slope. Overgrazing or grazing pasture when the soil is too wet causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is well suited to trees. Seedlings survive and grow well if competing vegetation is controlled. The control or removal of unwanted trees and shrubs can be accomplished by site preparation or by spraying, cutting, or girdling.

The limitation is severe on this soil for building sites because of the slope. Sites should be graded to modify the slope, and buildings should be designed to complement slope. Topsoil should be stockpiled and replaced on disturbed areas. Building sites should be revegetated soon after construction to prevent erosion.

The limitation is severe for local roads and streets because of slope. Roads should be cut and filled or designed to complement the slope.

The limitation is severe for septic tank absorption fields because of the slope and poor filtering quality of the soil. The filter field should be graded to modify the slope. Ground water contamination is possible in some areas because of the moderately rapid permeability.

This soil is in capability subclass IVe and woodland suitability subclass 3s.

OsE—Oshtemo loamy sand, 18 to 25 percent slopes. This soil is moderately steep, deep, and well drained. It is on knolls and hills on uplands and on narrow breaks along drainageways. This soil has few to common cobbles on the surface. Areas are irregular in shape. They are dominantly about 8 acres but range from 3 to 20 acres.

Typically, the surface layer is brown loamy sand about 6 inches thick. The subsoil is about 36 inches thick. The upper part of the subsoil is brown and dark brown sandy loam, and the lower part is dark brown sandy loam, and loamy sand. The substratum to a depth of 60 inches is grayish brown stratified coarse sand and fine gravelly sand. In small areas loose sand and gravel are at a depth of 30 to 40 inches. Some areas are moderately eroded and have a surface layer that consists of a mixture of the topsoil and upper part of subsoil.

Included with this soil in mapping are small areas of soils that are mostly sand or have a substratum of loamy sand or sandy loam. Also included are small areas of soils that have slopes of less than 18 percent, areas of soils 1/2 acre to 2 acres in size that have a surface layer of very gravelly loamy sand, and areas of severely eroded soils. The included soils make up 5 to 10 percent of this map unit.

Permeability is moderately rapid. Available water capacity and organic matter content are moderate. Surface runoff from cultivated areas is very rapid. The seasonal high water table is below a depth of 6 feet. The surface layer is friable and easily tilled through a fairly wide range of soil moisture.

Most areas of this soil are in woodland. A few areas are used for grasses and legumes for forage or pasture.

This soil is not suited to corn and soybeans because of the very severe hazard of erosion. Small grain is occasionally grown so that stands of grasses and legumes can be reestablished. The moderately steep slopes hinder the use of farm machinery. Minimum tillage, diversions, grassed waterways, and returning crop residue to this soil help prevent excessive soil loss in cultivated areas. A cropping system that includes

grasses and legumes most of the time is effective in controlling erosion and reducing surface runoff.

Grasses and legumes for forage or pasture are suited to this soil. The use of farm machinery is difficult because of the moderately steep slopes. Overgrazing or grazing when the soil is too wet causes surface compaction and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricting use during wet periods help keep this soil in good condition.

This soil is well suited to trees. Seedlings survive and grow well if competing vegetation is controlled. The control and removal of unwanted trees and shrubs can be accomplished by site preparation or by spraying, cutting, or girdling.

The limitation is severe on this soil for building sites and local roads and streets because of the moderately steep slopes. If this soil is used as a building site, development should be on the contour. Removal of vegetation should be held to a minimum and temporary plant cover should be established on disturbed areas to help prevent soil loss.

The limitation is severe for septic tank absorption fields because of the slope and poor filtering quality of this soil. Ground water contamination is possible because of the moderately rapid permeability.

This soil is in capability subclass VIe and woodland suitability subclass 3s.

OuB—Oshtemo-Hillsdale-Chelsea complex, 3 to 6 percent slopes. This complex consists of gently sloping, deep, well drained and excessively drained soils on uplands. These soils formed in glacial outwash, glacial till, and eolian sand. Areas are irregular in shape and range from 10 to 160 acres.

This map unit is about 40 percent Oshtemo soils, 30 percent Hillsdale soils, and 20 percent Chelsea soils. The Oshtemo soils are in irregularly shaped, undulating areas interspersed with Hillsdale soils on isolated ridges and Chelsea soils on knolls. Areas of these soils are so intricately mixed or so small in size that to separate them in mapping was not practical.

Typically, the Oshtemo soils have a surface layer of dark grayish brown loamy sand about 8 inches thick. The subsurface layer is brown sandy loam about 4 inches thick. The subsoil is about 40 inches thick. The upper part of the subsoil is brown and dark brown sandy loam, and the lower part is dark brown sandy loam and loamy sand. The substratum to a depth of 60 inches is grayish brown, stratified coarse sand and fine gravelly sand. In some areas the surface layer is lighter in color than is typical.

Typically, the Hillsdale soils have a surface layer of dark brown sandy loam about 10 inches thick. The subsurface layer is yellowish brown sandy loam about 3 inches thick. The subsoil is about 57 inches thick. The upper part of the subsoil is dark yellowish brown, strong brown, and yellowish brown, friable sandy loam, and the lower part is yellowish brown and brown, friable sandy loam. The substratum to a depth of 80 inches is yellowish brown sandy loam. In areas, this soil is finer textured in the subsoil and substratum than is typical, or pockets and strata of sand and gravel are present between the subsoil and substratum.

Typically, the Chelsea soils have a surface layer of brown fine sand about 10 inches thick. The subsurface layer to a depth of 36 inches is yellowish brown fine sand and sand. Below the subsurface layer to a depth of 70 inches is yellowish brown sand with 1/4 to 1 inch bands of brown loamy sand. In some areas, the underlying material below a depth of 60 inches is loam or silty clay loam, or the surface layer is sandy loam, or the upper part of the soil is neutral or slightly acid because of heavy liming.

Included with these soils in mapping are small areas of Boyer and Metea soils on positions similar to those of the major soils and small areas of Brady soils on lower positions and in drainageways. The included soils make up 10 percent of this map unit.

Permeability is moderately rapid in the Oshtemo soils, moderate in the Hillsdale soils, and rapid in the Chelsea soils. Available water capacity is moderate in Oshtemo and Hillsdale soils and low in Chelsea soils. In all of these soils organic matter content is moderate, surface runoff is slow, the seasonal high water table is below a depth of 6 feet, and the surface layer is friable or very friable and easy to till under proper moisture conditions. A few cobbles are generally on the surface of these soils.

Most areas of these soils are farmed. Many areas are used for corn, soybeans, and small grain. Some areas are used for hay or pasture, and a few areas are in woodland.

These soils are suited to corn, soybeans, and small grain. Droughtiness is a limitation, and erosion and soil blowing are hazards. Well distributed rainfall, particularly during midseason, is essential for good productivity. This soil is well suited to irrigation, and crop yields can be significantly increased with supplemental water. Minimum tillage and crop residue management help improve and maintain tilth and organic matter content.

Grasses and legumes for hay and pasture are well suited to these soils and are effective in controlling soil blowing and erosion. Well distributed rainfall increases yields of forage or pasture. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Overgrazing also reduces the plant density and plant hardiness. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help reduce surface compaction and maintain good tilth and plant densities.

These soils are well suited to trees. Seedlings survive and grow well if competing vegetation is controlled. The control or removal of unwanted trees and shrubs can be accomplished by site preparation or by spraying, cutting, or girdling.

The limitation is slight on these soils for building sites. Grading the site to modify the slope and designing the building to complement the slope are needed in places.

The limitation is slight for local roads and streets, except for the Hillsdale soil that has moderate limitation. To reduce frost action in the Hillsdale soil, drainage ditches are needed and the base material needs to be strengthened.

The limitation is severe for septic tank absorption fields, mainly because the filtering quality of the soil is poor. In some areas, ground water contamination is possible because of moderately rapid permeability in the Oshtemo and Chelsea soils.

These soils are in capability subclass IIIs. Oshtemo and Chelsea soils are in woodland suitability subclass 3s, and Hillsdale soils are in woodland suitability subclass 1o.

OuC—Oshtemo-Hillsdale-Chelsea complex, 6 to 12 percent slopes. This complex consists of moderately sloping, deep, well drained and excessively drained soils on uplands. Areas are irregular in shape and range from 5 to 160 acres.

This map unit is about 40 percent Oshtemo soils, 30 percent Hillsdale soils, and 20 percent Chelsea soils. The Oshtemo soils are on the irregularly shaped, undulating areas interspersed with Hillsdale soils on isolated ridges and Chelsea soils on knolls. Areas of these soils are so intricately mixed or so small in size that to separate them in mapping was not practical.

Typically, the Oshtemo soils have a surface layer of dark grayish brown loamy sand about 7 inches thick. The subsoil is about 40 inches thick. The upper part of the subsoil is brown and dark brown sandy loam, and the lower part is dark brown sandy loam and loamy sand. The substratum to a depth of 60 inches is grayish brown, stratified coarse sand and fine gravelly sand.

Typically, the Hillsdale soils have a surface layer of dark grayish brown sandy loam about 8 inches thick. The subsurface layer is brown sandy loam about 4 inches thick. The subsoil is dark yellowish brown and yellowish brown, friable sandy loam about 48 inches thick. The substratum to a depth of 84 inches is yellowish brown sandy loam. In some areas, depth to the substratum ranges from 30 to 42 inches, or the subsoil and substratum are finer textured than typical, or pockets and strata of sand and gravel are present between the subsoil and substratum.

Typically, the Chelsea soils have a surface layer of brown sand about 7 inches thick. The next layer is yellowish brown and about 50 inches thick. The upper part of this layer is sand, and the lower part is sand with 1/4 to 1 inch bands of brown loamy sand. In some areas the underlying material below a depth of 60 inches is loam or silty clay loam or the surface layer is sandy loam.

Included with these soils in mapping are small areas of Boyer and Metea soils on positions similar to the major soils and small areas of soils that have slopes of less than 6 percent or slopes of 12 to 18 percent. The included soils make up 10 percent of this map unit.

Permeability is moderately rapid in the subsoil and very rapid in the substratum of the Oshtemo soils. It is moderate in the Hillsdale soils and rapid in the Chelsea soils. Available water capacity is moderate for Oshtemo and Hillsdale soils and low for Chelsea soils. In all of these soils, organic matter content is moderate, surface runoff is medium, the seasonal high water table is below a depth of 6 feet, and the surface layer is friable or very friable and easy to till under proper moisture conditions. Some cobbles are generally on the surface of these soils.

Most of these soils are farmed. Many areas are used for corn, soybeans, and small grain. Some areas are used for hay or pasture, and a few areas are used for orchards or woodland.

These soils are suited to corn, soybeans, and small grain if erosion is controlled. Droughtiness is a limitation during seasons of prolonged, low rainfall, particularly when shallow-rooted crops are grown. Slope is a limitation for irrigation. In cultivated areas, management is needed to control erosion and surface runoff. Crop rotation, minimum tillage, terraces, diversions, contour farming, grassed waterways, or grade stabilization structures help prevent excessive soil loss. Crop residue management and cover crops also help control erosion and improve and maintain tilth and organic matter content.

Grasses and legumes for hay and pasture are well suited to these soils and are effective in controlling soil blowing and water erosion. Overgrazing or grazing when the soil is too wet causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

These soils are well suited to trees. Seedlings survive and grow well if competing vegetation is controlled. The control or removal of unwanted trees and shrubs can be accomplished by site preparation or by spraying, cutting, or girdling.

The limitation is moderate on these soils for building sites because of the slope. The site needs to be graded to modify the slope, and the buildings need to be designed to complement the slope. Revegetating disturbed areas soon after construction helps reduce erosion.

The limitation is moderate for local roads and streets because of slope in all of the soils and because of frost action in Hillsdale soils. The roadways need to be cut and filled to complement the slope. To reduce the effect of frost, drainage ditches are needed and the base material needs to be strengthened with a more suitable material.

The limitation is severe for septic tank absorption fields, mainly because of the poor filtering quality of these soils. The filter field should be graded to modify the slope. Ground water contamination is possible in some areas because of the moderately rapid to very

rapid permeability in the Oshtemo soils and rapid permeability in the Chelsea soils.

These soils are in capability subclass IIIe; Oshtemo and Chelsea soils are in woodland suitability subclass 3s and Hillsdale soils are in woodland suitability subclass 1o.

Pm—Palms muck, drained. This soil is nearly level, deep, and very poorly drained. It is on the lower elevations of outwash plains and uplands along drainageways and in the deeper depressions that have been drained. Runoff from adjacent, higher lying areas frequently ponds on the surface. Areas are generally small and irregular in shape. They are dominantly about 5 acres but range from 3 to 40 acres.

Typically, the surface layer is black muck about 11 inches thick. The next 15 inches is black and very dark gray muck. The substratum to a depth of 60 inches is grayish brown, mottled clay loam. In some areas, a thin layer of marl is in the upper part of the mineral substratum, or a thin layer of coprogenous earth underlies the mucky material, or the substratum is silty clay or clay. Some areas have only 12 to 16 inches of muck over the mineral material. Some areas are not drained.

Included with this soil in mapping are small areas of Houghton, Adrian, and Edwards soils on positions similar to this Palms soil and small narrow strips of very poorly drained mineral soils surrounding areas of Palms soils. Also included are areas that have considerable reddish brown or yellowish red iron oxide concretions and nodules on the surface or throughout the soil. These areas are shown on the soil map by a special symbol. The included soils make up 5 to 15 percent of this map unit.

Permeability is moderately slow to moderately rapid in the organic layers and moderately slow to moderate in the underlying material. Available water capacity and organic matter content are very high. Surface runoff is very slow or ponded. This soil has a seasonal high water table. The surface layer is friable and is easy to till under proper moisture conditions.

Most areas of this soil are farmed. Corn and soybeans are the main crops, but special crops and pasture are also grown.

If this soil is drained, it is suited to corn, soybeans, sweet corn, mint, onions, and potatoes. Strongly acid areas are suited to blueberries. Wetness is the main limitation to cultivated crops. The rooting depth is shallow because of the high water table. Soil blowing is a hazard when the soil is dry or void of vegetative cover. Overdrainage can cause excessive subsidence. Fire is a hazard when the organic material is dry because the muck will burn. Minimum tillage, cover crops, and crop residue management help improve and maintain tilth and reduce soil blowing.

Grasses for hay and pasture are well suited to this soil. This soil is poorly suited to deep-rooted legumes such as alfalfa because of the wetness. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the soil in good condition.

This soil is poorly suited to trees, however, water-tolerant hardwoods are commonly around the perimeter of this soil. The prolonged high water table is a limitation. Shrub windbreaks are beneficial in controlling soil blowing. The control and removal of unwanted trees and shrubs can be accomplished by site preparation or by spraying, cutting, and girdling.

The limitation is severe on this soil for building sites because of the excess humus and susceptibility to ponding. The muck is very unstable for building purposes, and piling is necessary in places. Drainage is difficult because most areas of this soil generally are in the lowest lying part of the landscape. Pumping is the only suitable means of drainage in some areas.

The limitation is severe for local roads and streets because of the ponding and low strength. Excavating the muck to an underlying mineral soil and adding a more suitable base material help overcome these limitations.

The limitation is severe for septic tank absorption fields because of the ponding. Commercial sewers and treatment facilities are generally needed.

This soil is in capability subclass IIw and woodland suitability subclass 4w.

PrA—Parr loam, 0 to 2 percent slopes. This soil is nearly level, deep, and well drained. It is on broad flats on uplands. Areas are broad, and range from 20 to 1,500 acres.

Typically, the surface layer is very dark brown loam about 9 inches thick. The subsurface layer is very dark grayish brown loam about 5 inches thick. The subsoil is dark yellowish brown, friable clay loam, and the lower part is yellowish brown, firm clay loam. The substratum to a depth of 70 inches is light yellowish brown loam. In most areas stratified sand and gravelly sand are beneath the loam glacial till. Depth to the sand and gravelly sand is dominantly 5 to 8 feet but in some areas is as deep as 10 feet. In areas, the subsoil has a higher content of silt than typical or the depth to the C horizon is more than 42 inches.

Included with this soil in mapping are a few small areas of Wawasee soils, Shipshe soils, and soils that have slopes of 2 to 6 percent. The included soils make up 5 to 10 percent of this map unit.

Permeability is moderate. Available water capacity and organic matter content are high. Surface runoff from cultivated areas is slow. The surface layer is friable and easily tilled through a fairly wide range of soil moisture.

Most areas of this soil are farmed. Many areas are used for corn, soybeans, and small grain. Some areas are used for hay or pasture, and very few areas are used for orchards or woodland.

This soil is well suited to corn, soybeans, and small grain. The main management needs are conservation of moisture and improvement of organic matter content and

fertility. Minimum tillage, crop rotation, cover crops, crop residue, and green manure crops help maintain tilth, organic matter content, and soil moisture.

Grasses and legumes for hay or pasture are well suited to this soil. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Overgrazing also reduces the plant density and plant hardiness. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help reduce surface compaction and maintain good tilth and plant densities.

This soil is well suited to trees, however, few trees are on this soil because of the original prairie vegetation.

The limitation is slight on this soil for dwellings with basements and moderate for dwellings without basements because of the shrinking and swelling of the soil. Proper design of foundations helps overcome this limitation.

The limitation is severe for local roads and streets because of the low strength. Mixing the subsoil with a coarser grade material or using soil additives helps overcome these limitations.

The limitation is moderate for septic tank absorption fields because of the moderate permeability. Increasing the size of the absorption field or placing laterals deeper in more permeable material helps overcome this limitation.

This soil is in capability class I. It is not assigned to a woodland suitability subclass.

Pt—Pewamo silty clay loam. This soil is nearly level, deep, and very poorly drained. It is on flats and in depressions or drainageways on uplands. Surface runoff from adjacent, higher lying areas frequently ponds on the surface. Areas are irregular in shape. They are dominantly about 20 acres but range from 5 to 100 acres.

Typically, the surface layer is very dark gray silty clay loam about 12 inches thick. The subsoil is about 32 inches thick. The upper part of the subsoil is dark gray and gray, mottled, firm silty clay loam, and the lower part is gray, mottled, firm silty clay and clay. The substratum to a depth of 60 inches is gray clay loam. In some areas, the surface layer is silt loam.

Included with this soil in mapping are small areas of Blount and Nappanee soils on low knolls and flats and areas of soils that have slopes of 2 to 3 percent and are in drainageways. The included soils make up 8 to 10 percent of this map unit.

Permeability is moderately slow. Available water capacity is high or very high. Organic matter content is high. Surface runoff from cultivated areas is very slow or ponded. This soil has a seasonal high water table, and water is ponded in some depressional areas early in spring. When the firm surface layer is too wet, tillage results in the formation of large clods. The clods become very firm when they dry and make seedbed preparation difficult.

Most areas of this soil are farmed. Many areas are used for hay and pasture and a few areas are used for woodland.

If this soil is adequately drained, it is well suited to corn, soybeans, and small grain. Wetness is the main limitation that affects use and management. Excessive water can be removed by open ditches, tile drains, surface drains, pumping, or a combination of these. If properly drained and managed, this soil is suited to intensive row cropping. Minimum tillage and crop residue management help improve and maintain tilth and organic matter content.

Grasses and legumes for hay or pasture are well suited to this soil. Drainage is needed to obtain high yields. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Overgrazing also reduces the plant density and plant hardiness. Proper stocking rates, rotational grazing, timely deferment of grazing, and restricted use during wet periods help reduce surface compaction and maintain good tilth and plant densities.

This soil is suited to trees. The main limitation is the seasonal high water table. Water-tolerant species are favored in timber stands. Harvesting and logging operations are delayed to dry seasons or when the ground is frozen. Seedlings survive and grow well if competing vegetation is controlled by cutting, spraying, or girdling.

The limitation is severe on this soil for building sites because of the ponding. Drainage is difficult in most areas because this soil is commonly in the lowest lying part of the landscape. Suitable outlets for drainage systems generally are not available, and pumping is needed.

The limitation is severe for local roads and streets because of the ponding and low strength. These limitations are possible to overcome by installing drainage ditches along side of the roadway or by conveying runoff water to a storm sewer or other suitable outlet.

The limitation is severe for septic tank absorption fields because of the ponding and moderately slow permeability. To overcome these limitations, the water table needs to be lowered by drainage systems and perimeter drains and the size of the absorption field needs to be increased. Commercial sewers are generally needed.

This soil is in capability subclass IIw and woodland suitability subclass 2w.

Pv—Pits, gravel. This miscellaneous area consists of open excavations where the soil materials have been removed to expose the underlying sand and gravel. The excavations are of variable depth. Where the water table is shallow, the pits contain water. Areas are generally square or rectangular and range from 3 to 40 acres.

Typically, pits, gravel, are in outwash areas of Boyer and Oshtemo soils. In some areas the excavations are in the sides of hills. In other areas the excavations are filled with water, and the sand and gravel is pumped out. In some pits, nearly all the sand and gravel have been removed, and the remaining material has too many fines for a suitable source of gravel.

Included with these miscellaneous areas in mapping are areas adjacent to the pits where soil material and sand and gravel have been dumped. The soil beneath these dumped materials is commonly similar to the adjacent soils.

Many pits in the county have been abandoned. The abandoned pits have very little agricultural or urban value in their natural state. They are generally suited only to wildlife habitat and recreation.

This map unit is not assigned to a capability subclass or woodland suitability subclass.

PxB—Plainfield sand, 2 to 6 percent slopes. This soil is gently sloping, deep, and excessively drained. It is on convex, undulating outwash areas and on side slopes of knolls and ridges on uplands. Areas are irregular in shape. They are dominantly about 20 acres but range from 3 to 80 acres.

Typically, the surface layer is very dark grayish brown sand about 9 inches thick. The subsoil is strong brown and yellowish brown sand about 23 inches thick. The substratum to a depth of 60 inches is brownish yellow and light yellowish brown sand.

Included with this soil in mapping are areas of Chelsea, Boyer, and Oshtemo soils on positions similar to this Plainfield soil and small areas of soils that have less than 2 percent slopes or more than 6 percent slopes. Also included are small, level or depressional areas and areas of soils that have scattered gravel on the surface. The included soils make up 8 to 14 percent of this map unit.

Permeability is rapid. Available water capacity and organic matter content are low. Surface runoff is slow. The seasonal high water table is below a depth of 6 feet. The surface layer is very friable and easily tilled through a wide range of soil moisture.

Some areas of this soil are farmed. Corn, soybeans, small grain, and hay or pasture are the main crops. A few areas are used for woodland, and extensive areas in the Pigeon River Fish and Wildlife Area are used for wildlife habitat.

This soil is suited to small grain. It is poorly suited to corn and soybeans. Corn and soybeans can be grown, but yields are commonly low because of the droughtiness. Early maturing row crops are less affected by droughtiness. This soil is well suited to irrigation, and crop yields can be significantly increased with supplemental water. Soil blowing is a problem. Water erosion is a problem early in spring when soil layers are frozen below the surface. Traction is poor for farm machinery. Frequent fertilizer and lime applications are necessary because of rapid leaching of nutrients. Minimum tillage and crop residue management help improve and maintain tilth and organic matter content.

Grasses and legumes for hay and pasture are suited to this soil, and they help to control soil blowing. Proper stocking rates, pasture rotation, and timely deferment of grazing help keep the pasture and soil in good condition.

This soil is suited to trees. Christmas trees, especially, are well suited. The limitation is severe on this soil for the use of equipment, the hazards of erosion and seedling mortality are moderate. Seedlings survive and grow well if competing vegetation is controlled. The control and removal of unwanted trees and shrubs can be accomplished by site preparation or by spraying, cutting, or girdling.

The limitation is slight on this soil for buildings with or without basements and for local roads and streets. This soil has severe limitations for septic tank absorption fields because the filtering quality of this soil is poor. Ground water contamination is possible because of the rapid permeability.

This soil is in capability subclass VIs and woodland suitability subclass 3s.

PxC—Plainfield sand, 6 to 12 percent slopes. This soil is moderately sloping, deep, and excessively drained. It is on irregularly shaped knolls, ridges, and elongated breaks along drainageways on uplands. Slopes are generally short. Areas are irregular in shape and range from 4 to 20 acres.

Typically, the surface layer is dark grayish brown sand about 7 inches thick. The subsoil is strong brown and yellowish brown sand about 20 inches thick. The substratum to a depth of 60 inches is brownish yellow and light yellowish brown sand.

Included with this soil in mapping are areas of Chelsea, Boyer, and Oshtemo soils on positions similar to this Plainfield soil, areas of soils that have less than 6 percent slopes or more than 12 percent slopes, and areas of soils that are moderately or severely eroded. The included soils make up 8 to 14 percent of this map unit.

Permeability is rapid. Available water capacity and organic matter content are low. Surface water runoff is medium. The seasonal high water table is below a depth of 6 feet. The surface layer is very friable and easily tilled through a wide range of soil moisture.

Some areas of this soil are farmed. Corn, soybeans, small grain, and hay or pasture are the main crops. A few areas are in woodland, and extensive areas in the Pigeon River Fish and Wildlife Area are used for wildlife habitat.

This soil is generally not suitable for corn and soybeans because of the droughtiness. Erosion and soil blowing are hazards on this soil. Irrigation is poorly suited because of the slope. Traction is poor for farm machinery. Frequent fertilizer and lime applications are needed because of the rapid leaching of nutrients. Minimum tillage and crop residue management help improve and maintain tilth and organic matter content.

Grasses and legumes for hay and pasture are suited to this soil, and they help to control soil blowing and erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help keep the pasture and soil in good condition.

This soil is suited to trees. Christmas trees, especially, are well suited. The limitation is severe on this soil for the use of equipment, and the hazards of erosion and seedling mortality are moderate. Seedlings survive and grow well if competing vegetation is controlled. The control and removal of unwanted trees and shrubs can be accomplished by site preparation or by spraying, cutting, or girdling.

The limitation is moderate on this soil for buildings with or without basements because of the slope. Building sites should be graded to modify slope, and buildings should be designed to complement slope. Topsoil should be stockpiled and replaced on disturbed areas, and these areas should be revegetated soon after construction to prevent erosion.

The limitation is moderate for local roads and streets because of the slope. Roads should be cut and filled or designed to complement the slope.

The limitation is severe for septic tank absorption fields because of the poor filtering quality of the soil. The filter field should be graded to modify the slope. Ground water contamination is possible in some areas because of the rapid permeability.

This soil is in capability subclass VIs and woodland suitability subclass 3s.

PzA—Plainfield loamy sand, 0 to 2 percent slopes. This soil is nearly level, deep, and excessively drained. It is on flats along major watercourses and on ridgetops and knolls on sandy outwash plains on uplands. Areas are irregular in shape. They are dominantly about 80 acres but range from 3 to 640 acres.

Typically, the surface layer is very dark grayish brown loamy sand about 9 inches thick. The subsoil is strong brown and yellowish brown sand about 24 inches thick. The substratum to a depth of 60 inches is brownish yellow and light yellowish brown sand.

Included with this soil in mapping are areas of Chelsea soils on positions similar to this Plainfield soil and small areas of Brems soils on slightly lower positions. Also included are small areas of soils that have slopes of more than 2 percent and soils that have scattered gravel on the surface. The included soils make up 8 to 14 percent of this map unit.

Permeability is rapid. Available water capacity and organic matter content are low. Surface runoff is slow. The seasonal high water table is below a depth of 6 feet. The surface layer is very friable and easily tilled through a wide range of soil moisture.

Some areas of this soil are farmed. Corn, soybeans, small grain, and hay or pasture are the main crops. A few areas are in woodland, and extensive areas in the Pigeon River Fish and Wildlife Area are used for wildlife habitat.

This soil is suited to small grain. It is poorly suited to corn and soybeans. Droughtiness is the main limitation. This soil is well suited to irrigation, and crop yields can be significantly increased with supplemental water. Soil blowing is a problem. Traction is poor for farm machinery. Frequent fertilizer and lime applications are needed because of the rapid leaching of nutrients. This soil has slightly higher production potential than Plainfield soils that have slopes of 2 to 6 percent. This is because more water is available to plants and the hazard of erosion is less on this nearly level soil. Also, less power is required to farm this soil than the sloping soils. Minimum tillage and crop residue management help improve and maintain tilth and organic matter content.

Grasses and legumes for hay are suited to this soil, and they help to control soil blowing. Proper stocking rates, pasture rotation, and timely deferment of grazing help keep the soil and pasture in good condition.

This soil is suited to trees. Christmas trees, especially, are well suited. The limitation is severe on this soil for the use of equipment, and the hazards of erosion and seedling mortality are moderate. Seedlings survive and grow well if competing vegetation is controlled. The control and removal of unwanted trees and shrubs can be accomplished by site preparation or by spraying, cutting, or girdling.

The limitation is slight on this soil for building sites and for local roads and streets. The limitation is severe for septic tank absorption fields because of the poor filtering quality of this soil. Ground water contamination is possible because of the rapid permeability.

This soil is in capability subclass IVs and woodland suitability subclass 3s.

RaB—Rawson sandy loam, 2 to 6 percent slopes. This soil is gently sloping, deep, and moderately well drained and well drained. It is on narrow breaks along drainageways and irregularly shaped knolls on uplands. This soil has few to common cobbles on the surface. Areas are irregular in shape. They are dominantly about 20 acres but range from 3 to 60 acres.

Typically the surface layer is dark grayish brown sandy loam about 9 inches thick. The subsurface layer is yellowish brown loam about 4 inches thick. The subsoil is about 26 inches thick. The upper part of the subsoil is brown and dark yellowish brown, friable and firm loam and clay loam, and the lower part is brown and yellowish brown, mottled, firm clay loam. The substratum to a depth of 60 inches is yellowish brown clay loam. In some areas, the depth to the substratum is more than 48 inches. In other areas the substratum is loam, where part of the subsoil has been mixed with the surface layer.

Included with this soil in mapping are small areas of the wetter Haskins soils in poorly defined drainageways; small areas of Metea, Morley, and Wawasee soils on positions similar to this Rawson soil; and small areas of soils that have slopes more than 6 percent or less than 2 percent. The included soils make up 10 to 15 percent of this map unit.

Permeability is moderate in the upper part of the profile and slow or very slow in the lower part. Available water capacity and organic matter content are moderate.

Surface runoff from cultivated areas is medium. The surface layer is friable and easily tilled through a fairly wide range of soil moisture.

Most areas of this soil are farmed. Corn, soybeans, and small grain are the main crops. A few areas are used for hay or pasture, and a few areas are in woodland.

This soil is suited to corn, soybeans, and small grain. The main management needs are conservation of moisture and improvement of organic matter content and fertility. In cultivated cropland, conservation is needed to control erosion and surface runoff. Crop rotation, minimum tillage, terraces, diversions, contour farming, grassed waterways, or grade stabilization structures are needed to prevent excessive soil loss. Returning crop residue to this soil and the use of cover crops in the cropping system help to control erosion and improve and maintain tilth and organic matter content. Seepy areas in some of the drainageways and swales need subsurface tile for adequate drainage.

Grasses and legumes for hay or pasture are well suited to this soil and are effective in helping to control erosion. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Overgrazing also reduces the plant density and plant hardiness. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to reduce surface compaction and maintain good tilth and plant densities.

This soil is well suited to trees. Seedlings survive and grow well if competing vegetation is controlled. The control or removal of unwanted trees and shrubs can be accomplished by site preparation or by spraying, cutting, or girdling.

The limitation is severe on this soil for building sites because of the shrink-swell potential. Foundations and footings should be designed to prevent structural damage caused by shrinking and swelling of the soil. Placing drain tile around foundations and backfilling along the foundation wall with sand and gravel help overcome the limitation. Adequate drainage is needed to lower the water table for buildings with basements.

The limitation is severe for local roads and streets because of the low strength. The base material needs strengthening with a more suitable material, so that it can support heavier loads.

The limitation is severe for septic tank absorption fields because of the slow permeability and wetness. Drainage is needed, and the filter field should be enlarged to overcome the slow to very slow permeability in this soil.

This soil is in capability subclass IIe and woodland suitability subclass 2o.

Rb—Rensselaer loam. This soil is nearly level, deep, and very poorly drained. It is in broad, irregularly shaped, depressional areas on terraces or outwash plains. Surface runoff from adjacent, higher lying areas frequently ponds on the surface of this soil. Areas are generally broad and irregular in shape. They are dominantly about 40 acres but they range from 3 to 120 acres.

Typically, the surface layer is very dark gray loam about 7 inches thick. The subsurface layer is very dark gray silty clay loam about 4 inches thick. The subsoil is about 33 inches thick. The upper part of the subsoil is dark gray and gray, mottled, firm clay loam, and the lower part is gray, stratified fine sandy loam and silty clay loam. The substratum to a depth of 60 inches is stratified fine sand, silt, clay loam, and silty clay loam. In some areas, the surface layer is silt loam, or it is highly organic material or muck less than 10 inches thick. In other areas, this soil is underlain with sand and gravelly sand or is underlain with loam till. Some small areas have an overwash 10 to 20 inches thick.

Included with this soil in mapping are small areas of Whitaker soils on low knolls and adjacent flats and small areas of Sebewa, Houghton, and Palms soils on positions similar to this Rensselaer soil. The included soils make up 5 to 10 percent of this map unit.

Permeability is slow. Available water capacity is high. Organic matter content in the surface layer is high. Surface runoff from cultivated areas is very slow or ponded. The seasonal high water table is near the surface, and water ponds in some depressional areas early in spring. The surface layer is friable and easy to work.

Most areas of this soil are farmed. Corn, soybeans, and wheat are the main crops. A few areas are used for hay or pasture, and a few are used for woodland.

If this soil is adequately drained, it is well suited to corn, soybeans, and small grain. Wetness is the main limitation that affects use and management. Excessive water can be removed by open ditches, tile drains, surface drains, pumping, or a combination of these. If this soil is drained and properly managed, it is suited to intensive row cropping. Minimum tillage and crop residue management help improve and maintain tilth and organic matter content.

Grasses and legumes for hay or pasture are well suited to this soil. Drainage is necessary to obtain high yields for forage or pasture. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Overgrazing also reduces the plant density and plant hardiness. Proper stocking rates, rotation grazing, timely deferment of grazing, and restricted use during wet periods help reduce surface compaction and maintain good tilth and plant densitites.

This soil is poorly suited to trees. The main limitation is the seasonal high water table. The limitation is severe for the use of equipment and for the hazards of seedling mortality and windthrow. Harvesting and logging operations are delayed until dry seasons of the year, or when the ground is frozen. Water-tolerant species are favored in timber stands. Seedlings survive and grow well if competing vegetation is controlled.

The limitation is severe on this soil for building sites because of the ponding. Drainage is difficult because

most areas of this soil are generally in the lowest lying part of the landscape. Suitable outlets for drainage systems such as storm sewers are not commonly available, and pumping is needed.

The limitation is severe for local roads and streets because of the low strength, ponding, and potential frost action. These limitations can be overcome by installing drainage ditches along the sides of the roadways or by conveying runoff water to a storm sewer or other suitable outlet.

The limitation is severe for septic tank absorption fields because of the ponding and slow permeability. The effects of the water table can be overcome by increasing the depth of soil material above the water table or by installing perimeter drains around the filter field. Commercial sewers are generally needed.

This soil is in capability subclass IIw and woodland suitability subclass 2w.

Se—Sebewa loam. This soil is nearly level and very poorly drained. It is in broad, depressional areas and drainageways on glacial outwash plains and valley trains. This soil is moderately deep over sand and gravel. Surface runoff from adjacent, higher lying areas frequently ponds on the surface. Areas are broad and irregular in shape. They are dominantly about 20 acres but range from 3 to 1,280 acres.

Typically, the surface layer is black loam about 11 inches thick. The subsoil is about 22 inches thick. The upper part of the subsoil is dark gray and dark grayish brown, mottled, firm clay loam, and the lower part is grayish brown, mottled, friable sandy clay loam. The substratum to a depth of 60 inches is dark grayish brown, stratified coarse sand and gravelly sand. Some areas have a layer of muck on the surface less than 10 inches thick, and some small areas have an overwash 10 to 20 inches thick.

Included with this soil in mapping are small areas of Gilford soils on positions similar to that of this Sebewa soil, small areas of Homer soils on higher lying positions, areas of soils that have reddish brown or yellowish brown iron oxide accumulations, and areas of soils less than 2 acres in size that are too wet to crop. The included soils make up 5 to 10 percent of this map unit.

Permeability is moderate in the upper part of the profile and rapid in the lower part. Available water capacity is moderate, and organic matter content is high. Surface runoff from cultivated areas is very slow or ponded. This soil has a seasonal high water table, and water ponds in some depressional areas early in spring. The surface layer is friable and easy to work.

Most areas of this soil are farmed. Corn, soybeans, and small grain are the main crops. Some areas are used for pasture, hay, or woodlots.

If this soil is adequately drained, it is well suited to corn, soybeans, and small grain. Wetness is the main limitation that affects use and management. Excessive water can be removed by open ditches, tile drains, surface drains, pumping, or a combination of these. If drained and properly managed, this soil is suited to intensive row cropping. Minimum tillage and crop residue management help improve and maintain tilth and organic matter content.

Grasses and legumes for hay or pasture are well suited to this soil. Drainage is needed to obtain high yields for forage or pasture. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Overgrazing also reduces the plant density and plant hardiness. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help reduce surface compaction and maintain good tilth and plant densities.

This soil is suited to trees. The seedling mortality and windthrow hazards are moderate, and equipment limitation is severe. Harvesting and logging operations are delayed to dry seasons of the year or when the ground is dry. Water-tolerant species are favored in timber stands. Seedlings survive and grow well when competing vegetation is controlled by cutting, spraying, or girdling.

The limitation is severe on this soil for building sites. Ponding is the main limitation. An adequate drainage system helps correct this limitation. Drainage is difficult because areas are flat, and suitable outlets are hard to find.

The limitation is severe for local roads and streets because of the frost action and ponding. Drainage is needed for roads to lower the water table so that frost action can be reduced.

The limitation is severe for septic tank absorption fields because of the ponding. Commercial sewer systems are generally needed.

This soil is in capability subclass IIw and woodland suitability subclass 2w.

ShA—Shipshe sandy loam, 0 to 2 percent slopes. This soil is nearly level and well drained. It is on outwash plains. It is moderately deep over sand and gravel. This soil has few to common cobbles on the surface. Areas are broad. They are dominantly about 320 acres but range from 5 to 600 acres.

Typically, the surface layer is very dark brown sandy loam about 8 inches thick. The subsurface layer is very dark brown sandy loam about 5 inches thick. The subsoil is about 23 inches thick. The upper part of the subsoil is dark brown gravelly sandy clay loam, and the lower part is dark brown gravelly sandy loam. The substratum to a depth of 60 inches is yellowish brown stratified sand and gravel. In some small areas, the subsoil contains less than 35 percent gravel throughout, or the depth to sand and gravel is more than 40 inches. In some small areas southwest of Lagrange the thickness of the surface layer is less than 7 inches.

Included with this soil in mapping are small areas of soils that have 40 to 75 percent gravel in the surface layer, small areas of sand, and in places areas of soils in which the subsoil has a higher content of silt than this

Shipshe soil. The included soils make up 3 to 5 percent of this map unit.

Permeability is moderate or moderately rapid in the subsoil and very rapid in the underlying material. Available water capacity is low, and organic matter content is high. Surface runoff from cultivated areas is slow. The seasonal high water table is below a depth of 6 feet. The surface layer is friable and easily tilled through a fairly wide range of soil moisture.

Most areas of this soil are farmed. Many areas are used for corn, soybeans, and small grain. Some areas are used for hay or pasture, and a very few areas are used for orchards or woodland.

This soil is well suited to corn, soybeans, and small grain. Droughtiness is the main limitation. Well distributed rainfall, particularly during midseason, is essential for good productivity. This soil is well suited to irrigation. Crop yields can be significantly increased with supplemental water. Minimum tillage and crop residue management help improve and maintain tilth and organic matter content.

Grasses and legumes for hay or pasture are well suited to this soil (fig. 7). Well distributed rainfall increases yields for forage or pasture. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Overgrazing also reduces the plant density and plant hardiness. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help reduce surface compaction and maintain good tilth and plant densities.

This soil is well suited to trees, however, very few trees are on these soils because of the original prairie vegetation.

The limitation is slight on this soil for building sites. It is moderate for local roads and streets because of the frost action. Drainage ditches are needed along the roadway to remove excess water and reduce the frost action potential.

The limitation is severe for septic tank absorption fields because of the poor filtering quality of this soil. Ground water contamination is possible in some areas because of the moderately rapid permeability.

This soil is in capability subclass IIs; it is not assigned to a woodland suitability subclass.

ShB—Shipshe sandy loam, 2 to 6 percent slopes. This soil is gently sloping and well drained. It is on the

Figure 7.—Excellent alfalfa pasture on Shipshe sandy loam, 0 to 2 percent slopes.

side slopes of ridges, knolls, and potholes and on side slopes of breaks along drainageways on outwash plains. This soil is moderately deep over sand and gravel. It has few to common cobbles on the surface. Areas are irregular in shape. They are dominantly about 10 acres but range from 3 to 80 acres.

Typically, the surface layer is black sandy loam about 8 inches thick. The subsurface layer is very dark brown sandy loam about 4 inches thick. The subsoil is about 20 inches thick. The upper part of the subsoil is dark brown very gravelly sandy loam, and the lower part is dark reddish brown very gravelly sandy loam. The substratum to a depth of 60 inches is yellowish brown, stratified gravelly sand and sand. In some small areas the subsoil is less than 35 percent gravel throughout, or the depth to sand and gravel is more than 40 inches, or the surface layer is less than 7 inches thick.

Included with this soil in mapping are small areas of soils that have 40 to 75 percent gravel in the surface layer; small areas of sand; and small areas of deep, well drained soils in depressions. The included soils make up 3 to 5 percent of this map unit.

Permeability is moderate or moderately rapid in the upper part of the profile and very rapid in the lower part. Available water capacity is low, and organic matter content is high. Surface runoff from cultivated areas is slow. The seasonal high water table is below a depth of 6 feet. The surface layer is friable and easily tilled through a fairly wide range of soil moisture.

Most areas of this soil are farmed. Many areas are used for corn, soybeans, and small grain. Some areas are used for hay or pasture, and a very few areas are used for orchards or woodland.

This soil is suited to corn, soybeans, and small grain. Droughtiness is a limitation, and erosion is a hazard on this soil. Well distributed rainfall, particularly during midseason, is essential for good productivity. This soil is well suited to irrigation. Crop yields can be significantly increased with supplemental water. Minimum tillage and crop residue management help improve and maintain tilth and organic matter content.

Grasses and legumes for hay and pasture are well suited to this soil and are effective in controlling erosion. Well distributed rainfall increases yields of forage or pasture. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Overgrazing also reduces the plant density and plant hardiness. Proper stocking rates, rotation grazing, timely deferment of grazing, and restricted use during wet periods help reduce surface compaction and maintain good tilth and plant densities.

This soil is well suited to trees, however, very few trees are on these soils because of the original prairie vegetation.

The limitation is slight on this soil for dwellings with or without basements. It is moderate for local roads and streets because of the frost action. Drainage ditches are needed along the roadway to remove excess water and reduce the frost action potential.

The limitation is severe for septic tank absorption fields because of the poor filtering quality of this soil. Ground water contamination is possible in some areas because of the moderately rapid permeability.

This soil is in capability subclass IIIe. It is not assigned to a woodland suitability subclass.

ShC—Shipshe sandy loam, 6 to 12 percent slopes. This soil is moderately sloping and well drained. It is on the side slopes of ridges, knolls, and potholes and on side slopes of breaks along drainageways on outwash plains. This soil is moderately deep over sand and gravel. It has few to common cobbles on the surface. Areas are irregular in shape. They are dominantly about 8 acres but range from 3 to 20 acres.

Typically, the surface layer is black sandy loam about 8 inches thick. The subsurface layer is very dark brown sandy loam about 3 inches thick. The subsoil is dark brown and dark reddish brown very gravelly sandy loam about 16 inches thick. The substratum to a depth of 60 inches is yellowish brown, stratified gravelly sand and sand. In some small areas, the subsoil contains less than 35 percent gravel throughout, or sand and gravel are at a depth of more than 40 inches.

Included with this soil in mapping are small areas of soils that have 40 to 75 percent gravel in the surface layer, small areas of sand, and small areas of Boyer soils. Also included are areas of severely eroded soils that have a reddish brown surface layer. The included soils make up 3 to 5 percent of this map unit.

Permeability is moderate or moderately rapid in the upper part of the profile and very rapid in the lower part. Available water capacity is low, and organic matter content is high. Surface runoff from cultivated areas is medium. The seasonal high water table is below a depth of 6 feet. The surface layer is friable and easily tilled through a fairly wide range of soil moisture.

Most areas of this soil are generally farmed with the adjacent, less sloping Shipshe soils. Many areas are used for corn, soybeans, and small grain. Some areas are used for hay or pasture, and a very few areas are used for orchards or woodland.

This soil is suited to corn, soybeans, and small grain. Droughtiness is a limitation, and soil erosion is a hazard on this soil. Slope is a limitation to irrigation. In cultivated cropland, conservation management is needed to control erosion and surface runoff. Well distributed rainfall, particularly during midseason, is essential for good productivity. Minimum tillage and crop residue management help improve and maintain tilth and organic matter content.

Grasses and legumes for hay and pasture are well suited to this soil and are effective in controlling erosion. Well distributed rainfall increases yields for forage or pasture. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Overgrazing also reduces the plant density and plant hardiness. Proper stocking rates, rotation grazing, timely deferment of grazing, and restricted use during wet periods help

reduce surface compaction and maintain good tilth and plant densities.

This soil is well suited to trees, however, very few trees are on this soil because of the original prairie vegetation.

The limitation is moderate on this soil for dwellings with or without basements because of the slope. Building sites should be graded to modify slope, and buildings should be designed to complement slope. Disturbed areas should be revegetated soon after construction to prevent erosion. Topsoil should be stockpiled and replaced on disturbed areas.

The limitation is moderate for local roads and streets because of the frost action and slope. Drainage ditches aré needed along roadways to remove excess water and reduce the frost action potential.

The limitation is severe for septic tank absorption fields because of the poor filtering quality of this soil. The filter field should be graded to modify the slope. Ground water contamination is possible in some areas because of the moderately rapid permeability.

This soil in in capability subclass IIIe. It is not assigned to a woodland suitability subclass.

Ud—Udorthents, loamy. These soils are deep and well drained or moderately well drained. They are dominantly nearly level, but are gently sloping or moderately sloping in some areas. Areas of these soils contain fill material. The fill is mainly soil material, but in some places it contains such material as discarded brick, stones, wood, and metal. Areas are generally irregular in shape, but are elongated around the borders of some lakes. They range from 3 to 40 acres.

Typically, the surface layer is dark grayish brown loam or sandy loam about 8 inches thick. Between depths of 8 and 60 inches, the soil is dominantly yellowish brown loam, clay loam, and sandy loam.

Included with these soils in mapping are small areas of Houghton, Wawasee, Boyer, Plainfield, and Conover soils.

These soils are variable, however, permeability and available water capacity generally are moderate. Organic matter content is generally low but is moderate where muck has been mixed with the soil. The seasonal high water table is at a depth of 3 to 6 feet or more.

Most areas of these soils are used for building sites. Some areas, especially along the Indiana Toll Road, are used for pasture or are idle. A very few areas are used for crops or are used for woodland.

These soils are not suited to corn or soybeans. Some areas are suited to small grain or grasses and legumes for hay and pasture. Most areas in which houses have been built are suited to lawns and gardens; generally, topsoil has been spread on the surface of these areas so that grass can be grown. Where these soils are used for plants, lime and fertilizer need to be added according to soil tests and plant needs. Seedling mortality is a problem to the planting of trees and shrubs in places.

Onsite investigation is needed before these soils are used for building sites. Depth to the water table should be checked late in winter or early in spring. Many areas of these soils, especially those surrounding lakes, are underlain with chalk or marl. In these areas pilings are needed in places for buildings, and the underlying muck and marl needs to be removed for construction of local roads and streets. Commercial sewers are generally needed.

These soils are not assigned to a capability subclass or a woodland suitability subclass.

Wa—Wallkill silt loam. This soil is nearly level, deep, and very poorly drained. It is in depressional areas on uplands and outwash plains. Surface runoff from adjacent, higher lying areas frequently ponds on the surface. Areas are circular or oblong in depressions and narrow and elongated below eroded slopes. They range from 3 to 10 acres.

Typically, the surface layer is dark grayish brown silt loam about 9 inches thick. The subsoil is gray, mottled silt loam about 8 inches thick. The underlying material between depths of 17 and 21 inches is gray mottled silt loam. Beneath this to a depth of about 60 inches is black organic material. In some areas, the mineral material is less than 16 inches thick over the organic deposits.

Included with this soil in mapping are small areas of very poorly drained Rensselaer and Sebewa soils. The included soils make up 3 to 5 percent of this map unit.

Permeability is moderate in the mineral layers and moderately rapid or rapid in the organic layers. Available water capacity is very high, and organic matter content is high. Surface runoff is very slow. The seasonal high water table is at the surface, and water ponds on this soil during wet seasons. The surface layer is friable and easily tilled through a fairly wide range of soil moisture.

Most areas of this soil are farmed. Because areas of this soil are small, they are commonly farmed with the adjacent soils. Most areas are used for corn, soybeans, and small grain. Some areas are used for pasture and a very few areas are in woodland.

If this soil is drained, it is suited to corn, soybeans, sweet corn, mint, onions, and potatoes. Drainage has been established on most areas, however, some areas are still in their natural state. Wetness is the main limitation. Excessive water can generally be removed by open ditches, tile drains, surface drains, pumping, or a combination of these. Minimum tillage, cover crops, and crop residue management help improve and maintain tilth.

Grasses for hay and pasture are well suited to this soil. Deep-rooted legumes, such as alfalfa are poorly suited because of the wetness. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the soil in good condition.

This soil is poorly suited to trees. The limitation is severe for use of equipment, and the hazards of seed-

ling mortality and windthrow are severe. Water-tolerant species are favored in timber stands. The control and removal of unwanted trees and shrubs can be accomplished by site preparation or by spraying, cutting, and girdling.

The limitation is severe on this soil for building sites because of the low strength and ponding. The muck is very unstable for building purposes. Piling is generally necessary, assuming a mineral layer can be reached beneath the muck. Drainage is difficult in most areas because this soil is commonly in the lowest lying part of the landscape. Pumping is the only suitable means of draining areas in some places.

The limitation is severe for local roads and streets because of the low strength and ponding. Excavating the muck to an underlying mineral soil helps overcome the low strength in places.

The limitation is severe for septic tank absorption fields because of the seasonal high water table or ponding. Commercial sewers are generally needed.

This soil is in capability subclass IIIw and woodland suitability subclass 4w.

WeA—Wawasee fine sandy loam, 0 to 2 percent slopes. This soil is nearly level, deep, and well drained. It is on broad flats on uplands. This soil has few to common cobbles on the surface. Areas are irregular in shape. They are dominantly about 40 acres but range from 3 to 160 acres.

Typically, the surface layer is dark yellowish brown fine sandy loam 9 inches thick. The subsurface layer is yellowish brown sandy loam about 3 inches thick. The subsoil is about 19 inches thick. The upper part of the subsoil is yellowish brown, firm loam, and the lower part is yellowish brown, firm sandy loam and loam, and to a depth of 85 inches it is stratified sand and gravel. The till is generally underlain with sand and gravelly sand at a depth of 5 to 8 feet. In some areas, depth to the subsoil is 42 to 54 inches.

Included with this soil in mapping are small, narrow breaks that are along depressions and around potholes and have slopes of 2 to 6 percent. Also included are small areas of Metea and Chelsea soils and small areas of Parr soils in elongated, depressional areas and potholes. The included soils make up 5 to 10 percent of this map unit.

Permeability is moderate. Available water capacity and organic matter content are moderate. Surface runoff from cultivated areas is slow. The surface layer is friable and easily tilled through a fairly wide range of soil moisture.

Most areas of this soil are farmed. Many areas are used for corn, soybeans, and small grain. Some areas are used for hay or pasture, and a few areas are in orchards or woodland.

This soil is well suited to corn, soybeans, and small grain. The main management needs are conservation of moisture and improvement of organic matter content and fertility. Minimum tillage, crop rotation, cover crops, crop residue, and green manure crops help maintain tilth and organic matter content and control loss of soil moisture.

Grasses and legumes for hay or pasture are well suited to this soil. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Overgrazing also reduces the plant density and plant hardiness. Proper stocking rates, pasture rotation, timely deferment of grazing and restricted use during wet periods help reduce surface compaction and maintain good tilth and plant densities.

This soil is well suited to trees. Seedlings survive and grow well if competing vegetation is controlled. The control or removal of unwanted trees and shrubs can be accomplished by site preparation or by spraying, cutting, or girdling.

The limitation is slight for building sites. It is moderate for local roads and streets because of the frost action. Mixing the subsoil with a coarser grade material helps overcome this limitation. The limitation is slight for septic tank absorption fields.

This soil is in capability class I and woodland suitability subclass 1o.

WeB—Wawasee fine sandy loam, 2 to 6 percent slopes. This soil is gently sloping, deep, and well drained. It is on knolls and ridges along drainageways and depressions on uplands. This soil has few to common cobbles on the surface. Areas are generally broad and irregular in shape. They are dominantly about 20 acres but range from 5 to 160 acres.

Typically, the surface layer is dark grayish brown fine sandy loam about 8 inches thick. The subsurface layer is yellowish brown loam about 4 inches thick. The subsoil is dark yellowish brown, firm loam about 26 inches thick. The substratum to a depth of 60 inches is brown loam. In some areas depth to the substratum is more than 42 inches. Some areas are eroded, and nearly all of the surface layer has been removed or is mixed with the upper part of the subsoil. Some areas near Topeka and Wall Lake are underlain with sand and gravel at a depth of 5 to 8 feet.

Included with this soil in mapping are small areas of Conover soils in swales and drainageways and Chelsea, Hillsdale, and Metea soils on positions similar to this Wawasee soil. Also included are small areas of soils that have slopes of 0 to 2 percent or of 6 to 12 percent and areas, 1 to 3 acres in size, that are wet during most of the year. The included soils make up 5 to 10 percent of this map unit.

Permeability is moderate. Available water capacity and organic matter content are moderate. Surface runoff from cultivated areas is medium. The surface layer is friable and easily tilled through a fairly wide range of soil moisture.

Most areas of this soil are farmed. Many areas are used for corn, soybeans, and small grain. Some areas are used for hay or pasture, and few areas are used for orchards or woodland.

This soil is well suited to corn, soybeans, and small grain. This soil is susceptible to erosion. In cultivated areas, conservation management is needed to help control erosion and surface runoff. Crop rotation, minimum tillage, terraces, diversions, contour farming, grassed waterways, or grade stabilization structures help prevent excessive soil loss. Crop residue and cover crops help control erosion and improve and maintain tilth and organic matter content.

Grassess and legumes for hay or pasture on this soil help control soil blowing and water erosion. Overgrazing or grazing when the soil is too wet will cause surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is well suited to trees. Seedlings survive and grow well if competing vegetation is controlled. The control or removal of unwanted trees and shrubs can be accomplished by site preparation or by spraying, cutting, or girdling.

The limitation is slight on this soil for dwellings. It is moderate for local roads and streets because of the frost action. Providing good drainage ditches to remove excess water helps overcome this limitation. The limitation is slight for septic tank absorption fields.

This soil is in capability subclass IIe and woodland suitability subclass 1o.

WeC2—Wawasee fine sandy loam, 6 to 12 percent slopes, eroded. This soil is moderately sloping, deep, and well drained. It is on knolls and ridges on uplands and on long slopes along the leading edges of moraines. This soil has few to common cobbles on the surface. Areas are elongated or irregular in shape. They are dominantly about 10 acres but range from 3 to 80 acres.

Typically, the surface layer is dark grayish brown fine sandy loam about 8 inches thick. The subsoil is about 26 inches thick. The upper part of the subsoil is yellowish brown, firm loam, and the lower part is dark yellowish brown and dark brown, firm loam and sandy clay loam. The substratum to a depth of 60 inches is brown loam. In some areas depth to the substratum is more than 42 inches.

Included with this soil in mapping are small areas of Chelsea, Hillsdale, and Metea soils on positions similar to this Wawasee soil and a few small areas of soils that have slopes of 2 to 6 percent or 12 to 18 percent. Also included are small areas of severely eroded soils, generally less than 1 acre in size. The eroded areas and wet spots are indicated on the soil map by special symbols. The included soils make up 5 to 10 percent of this map unit.

Permeability is moderate. Available water capacity and organic matter content are moderate. Surface runoff from cultivated areas is rapid. The surface layer is friable and easily tilled through a fairly wide range of soil moisture.

Most areas of this soil are farmed along with the adjacent less sloping Wawasee soils. Many areas are used for corn, soybeans, and small grain. Some areas are used for hay or pasture, and a few areas are used for orchards or woodland.

If erosion is controlled, this soil is suited to corn, soybeans, and small grain. In areas of cultivated crops, conservation management is needed to control erosion and surface runoff. Crop rotation, minimum tillage, terraces, diversions, contour farming, grassed waterways, or grade stabilization structures help prevent excessive soil loss. Crop residue and cover crops also help control erosion and improve and maintain tilth and organic matter content.

This soil is well suited to grasses and legumes for hay and pasture. The use of this soil for hay or pasture is effective in controlling soil blowing and water erosion. Overgrazing or grazing when the soil is too wet causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, additions of lime and fertilizer according to soil tests and plant needs, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is well suited to trees. Seedlings survive and grow well if competing vegetation is controlled. The control or removal or unwanted trees and shrubs can be accomplished by site preparation or by spraying, cutting, or girdling.

The limitation is moderate for dwellings because of the slope. Sites need to be graded to modify the slope, and buildings need to be designed to complement the slope. Topsoil should be stockpiled and replaced on the disturbed areas. Building sites should be revegetated soon after construction to prevent erosion.

The limitation is moderate for local roads and streets because of the frost action and slope. The frost action can be partially overcome by mixing this soil with coarser textured soil, by using a more suitable base material, and by providing drainage ditches to remove excess water. The roadway needs to be cut and filled and designed to complement the slope.

The limitation is moderate for septic tank absorption fields because of the slope. The filter field needs to be graded to modify the slope.

This soil is in capability subclass IIIe and woodland suitability subclass 1o.

WeD2—Wawasee fine sandy loam, 12 to 18 percent slopes, eroded. This soil is strongly sloping, deep, and well drained. It is on knolls and ridges on uplands and on slopes along the leading edges of moraines. This soil has few to common cobbles on the surface. Areas are irregular in shape. They are dominantly about 8 acres but range from 3 to 40 acres.

Typically, the surface layer is brown fine sandy loam about 7 inches thick. The subsoil is about 25 inches thick. The upper part of the subsoil is yellowish brown,

firm loam, and the lower part is dark yellowish brown and dark brown, firm loam and sandy clay loam. The substratum to a depth of 60 inches is brown loam. In some areas, depth to the substratum is more than 42 inches, and in places the surface layer and the upper part of the subsoil contain more sand than is typical.

Included with this soil in mapping are small areas of soils that have slopes of less than 12 percent or more than 18 percent. Also included are small areas of soils that are severely eroded and the sandy clay loam or loam subsoil is on the surface. The included soils make up 5 to 10 percent of this map unit.

Permeability is moderate. Available water capacity and organic matter content are moderate. Surface runoff from cultivated areas is very rapid. The surface layer is friable and easily tilled through a fairly wide range of soil moisture.

Most areas of this soil are used for wheat, grasses, and legumes for forage or pasture. Some areas are in woodland, and a few areas are used for cultivated crops.

This soil is poorly suited to corn, soybeans, and small grain because of the very severe hazard of erosion. Most crops are grown so that stands of grasses and legumes can be re-established. Conservation management is needed in areas of cultivated crops to help control erosion and surface runoff. Minimum tillage, diversions, grassed waterways, and returning crop residue to this soil help prevent excessive soil losses.

Grasses and legumes for hay and pasture are well suited to this soil. If grasses and legumes are in the cropping system most of the time, they are effective in reducing runoff and controlling erosion. Most areas of this soil are in narrow bands and generally surrrounded by large areas of similar, less sloping soils that are used for row crops. Erosion control is difficult if this strongly sloping soil is cropped with the surrounding soils.

Areas of this soil are commonly left in grasses when the surrounding areas are cultivated, because this is effective in preventing erosion. When this soil is used for pasture, overgrazing or grazing when the soil is too wet causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is well suited to trees. Seedlings survive and grow well if competing vegetation is controlled. The control or removal of unwanted trees and shrubs can be accomplished by site preparation or by spraying, cutting, or girdling.

The limitation is severe for building sites because of the slope. Sites need to be graded to modify the slope, and the buildings need to be designed to complement the slope. Topsoil should be stockpiled and replaced on disturbed areas. Building sites should be revegetated soon after construction to help prevent erosion.

The limitation is severe for local roads and streets because of the slope. The roadway needs to be cut and filled and designed to complement the slope.

The limitation is severe for septic tank absorption fields because of the slope. The filter field needs to be graded to modify the slope.

This soil is in capability subclass IVe and woodland suitability subclass 1o.

WhC3—Wawasee loam, 6 to 12 percent slopes, severely eroded. This soil is moderately sloping, deep, and well drained. It is on irregularly shaped knolls and narrow, elongated breaks along drainageways and depressions on uplands. This soil has few to common cobbles on the surface. Areas are generally elongated and irregular in shape. They are dominantly about 5 acres but range from 3 to 40 acres.

Typically, the surface layer is yellowish brown, firm loam about 4 inches thick. The subsoil is yellowish brown and dark brown, firm loam about 24 inches thick. The substratum to a depth of 60 inches is light yellowish brown loam. In some areas, the plow layer is a mixture of the original surface layer of fine sandy loam and the upper part of the subsoil.

Included with this soil in mapping are a few small areas of soils that have slopes of 12 to 18 percent or 2 to 6 percent. Also included are a few small areas of soils that are not eroded and areas that have gullies 1 to 2 or more feet deep. The included soils make up 5 to 10 percent of this map unit.

Permeability and available water capacity are moderate. Organic matter content is low. Surface runoff from cultivated areas is rapid. The surface layer is firm. Tilling within the proper range of soil moisture reduces compaction of the soil and the tendency of clodding.

Most areas of this soil are farmed with adjoining less sloping soils. Many areas are used for corn, soybeans, and small grain. Some areas are used for hay and pasture, and some areas are in woodland.

This soil is poorly suited to corn, soybeans, and small grain because of the very severe hazard of erosion. Crop rotation, minimum tillage, terraces, diversions, contour farming, grassed waterways, and grade stabilization structures are needed to help control erosion and surface runoff and prevent excessive soil loss. Combinations of these measures are generally needed. Crop residue needs to be returned to this soil and cover crops need to be grown to help reduce surface runoff, control erosion, and maintain tilth and organic matter content.

Grasses and legumes for hay and pasture are effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is well suited to trees. Seedlings survive and grow well if competing vegetation is controlled. The control or removal of unwanted trees and shrubs can be accomplished by site preparation or by spraying, cutting, or girdling.

The limitation is moderate on this soil for dwellings because of the slope. Designing the building to conform to the landscape or leveling the slope by cutting and filling helps overcome this limitation.

The limitation is moderate for local roads and streets because of the low strength, slope, and frost action. Mixing this soil with a coarser textured soil or using a more suitable base material such as sand and gravel helps overcome the low strength and frost action. The roadway needs to be cut and filled and designed to complement the slope.

The limitation is moderate for septic tank absorption fields because of the slope. The filter field needs to be graded to modify the slope.

This soil is in capability subclass IVe and woodland suitability subclass 1o.

WhD3—Wawasee loam, 12 to 18 percent slopes, severely eroded. This soil is strongly sloping, deep, and well drained. It is on irregularly shaped knolls and narrow, elongated breaks along drainageways and depressions on uplands. This soil has few to common cobbles on the surface. Areas are generally elongated and irregular in shape. They are dominantly about 10 acres but range from 3 to 25 acres.

Typically, the surface layer is yellowish brown, firm loam about 4 inches thick. The subsoil is yellowish brown and dark brown, firm loam about 22 inches thick. The substratum to a depth of 60 inches is light yellowish brown loam. In some areas the plow layer is a mixture of the original surface layer and the upper part of the subsoil.

Included with this soil in mapping are small areas of soils that have slopes of 6 to 12 percent or slopes of 18 to 30 percent. Also included are areas of soils in which the moderately alkaline substratum is exposed on the surface, areas that have gullies 1 foot to 2 or more feet deep, and small, eroded areas used for woodland. The included soils make up 5 to 10 percent of this map unit.

Permeability and available water capacity are moderate. Organic matter content is low because the original surface layer has been removed by erosion. Surface runoff from cultivated areas is very rapid. The surface layer of this soil is firm. Tilling within the proper range of soil moisture reduces compaction of the soil and the tendency of clodding.

Very few areas of this soil are farmed. Grasses and legumes for forage or pasture are the major crops. Some areas are used for woodland.

This soil is generally not suitable for corn and soybeans because of the very severe hazard of erosion. Small grain is occasionally grown so that stands of grasses and legumes can be reestablished. Minimum tillage, diversions, grassed waterways, and returning crop residue to this soil help prevent excessive soil loss. Crop rotations that include grasses and legumes most of the time are effective in reducing surface runoff and controlling erosion.

Grasses and legumes for forage and pasture are suited to this soil. Some areas are commonly left in grass because of the difficulty in establishing seedlings and because some areas have gullies that are difficult to cross with farm machinery. If this soil is used for pasture, overgrazing or grazing when the soil is too wet causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is well suited to trees. Seedlings survive and grow well if competing vegetation is controlled. The control or removal of unwanted trees and shrubs can be accomplished by site preparation or by spraying, cutting, or girdling.

The limitation is severe on this soil for building sites because of the slope. Designing the building to conform to the landscape and leveling the slope by cutting and filling help overcome this limitation.

The limitation is moderate for local roads and streets because of the slope and frost action. Mixing this soil with a coarser textured soil or using a more suitable base material such as sand and gravel and providing ditches to remove excess water help overcome the frost action. Roadways need to be graded to conform to the slope.

The limitation is severe for septic tank absorption fields because of the slope. Increasing the size of the filter field or grading the filter field to conform with the slope helps overcome this limitation.

This soil is in capability subclass VIe and woodland suitability subclass 1o.

Wt—Whitaker sandy loam. This soil is nearly level, deep, and somewhat poorly drained. It is on flats along the edges of depressions and in drainageways on lake plains, uplands, or outwash plains. Areas are irregular in shape. They are dominantly about 20 acres but range from 5 to 80 acres.

Typically the surface layer is dark grayish brown sandy loam about 10 inches thick. The subsurface layer is brown sandy loam about 4 inches thick. The subsoil is about 25 inches thick. The upper part of the subsoil is grayish brown, mottled, friable sandy clay loam, and the lower part is yellowish brown, mottled, friable loam. The substratum to a depth of 60 inches is mottled, light olive brown and light brownish gray, stratified fine sand, silt, and silty clay loam. In some areas the surface layer is very dark grayish brown, or the calcareous substratum is within a depth of 36 inches.

Included with this soil in mapping are small areas of Rensselaer soils in depressions and drainageways and Conover and Homer soils on similar positions to this Whitaker soil. The included soil make up 5 to 10 percent of this map unit.

Permeability is moderate. Available water capacity is high. Organic matter content is moderate. Surface runoff from cultivated areas is slow. The seasonal high water

table is at a depth of 1 foot to 3 feet. The surface layer is friable and easy to work under proper moisture conditions.

Most areas of this soil are farmed. Many areas are used for corn, soybeans, or small grain. A few areas are used for hay or pasture or are used for woodland.

In most areas this soil is well suited to corn, soybeans, and small grain, because drainage has been established. Wetness is the major limitation in use and management. Excessive water can be removed by tile drains or surface drains. If drainage is adequate, a conservation cropping system that includes row crops most of the time is used. Many open ditches in areas of this soil help control wetness. Minimum tillage, crop residue management, and cover crops help improve and maintain tilth and organic matter content.

Grasses and legumes for hay and pasture are well suited to this soil. Drainage is necessary to obtain high yields for forage or pasture. The selection of legume depends on completeness of drainage. Alfalfa is not well suited because of wetness and frost heaving. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Overgrazing also reduces the plant hardiness and plant density. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help reduce surface compaction and maintain good tilth and plant densities.

This soil is suited to trees. The limitation is moderate for the use of equipment. Harvesting and logging operations are commonly delayed until dry seasons of the year. Water-tolerant species are favored in timber stands. Seedlings survive and grow well if competing vegetation is controlled. The control or removal of unwanted trees and shrubs can be accomplished by site preparation or by spraying, cutting, or girdling.

The limitation is severe on this soil for building sites because of the seasonal high water table at a depth of 1 to 3 feet. If an adequate drainage system in combination with storm sewers is installed, the water table can be lowered. Foundations and footings should be designed to prevent structural damage caused by shrinking and swelling. Placing drain tile around foundations and backfilling along the foundation wall with sand and gravel help overcome the high water table. Houses without basements are better suited than houses with basements.

Limitation is severe for local roads and streets because of the frost action and low strength. Drainage is needed for roads to lower the water table and reduce the frost action. The roadbase needs to be strengthened with a more suitable material.

The limitation is severe for septic tank absorption fields because of the seasonal high water table. Increasing the depth of soil material above the water table and installing perimeter drains around the filter field or installing a sanitary sewer system after drainage is installed helps overcome the high water table.

This soil is in capability subclass IIw and woodland suitability subclass 3o.

Use and management of the soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops and pasture

Ed Stuff, District conservationist, Soil Conservation Service, assisted in the preparation of this section.

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Soil maps for detailed planning." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

In 1967, 186,834 acres in the survey area was used for crops and pasture (*3*). Of this total, 22,214 acres was

used for permanent pasture; 69,221 acres was used for row crops, mainly corn; 26,379 acres was rotated in hay and pasture; 2,578 acres was used for hayland; 198 acres was used for orchards, vineyards, and bush fruit; and the rest was idle cropland.

The potential of the soils in Lagrange County for increased production of food is good. About 7,933 acres of potentially good cropland is currently used as woodland, and about 7,140 acres is used as pasture. In addition to the reserve productive capacity represented by this land, food production could also be increased considerably by extending the latest crop production technology to all cropland in the county. Several thousand acres would benefit considerably from irrigation. This soil survey can greatly facilitate the application of such technology.

In the last few years, land use in the county has changed very little. Some cropland and pasture, however, is lost each year because it is converted to urban use. This is not a serious problem at this time. The use of this soil survey to help make decisions to influence the future role of farming in the county is discussed in the section "General soil map for broad land use planning."

Soil drainage is the major concern on about 40 percent of the cropland and pasture in Lagrange County. Most of the very poorly drained soils, such as Gilford, Granby, Pewamo, Rensselaer, and Sebewa soils, can be satisfactorily drained for farming. However in many areas of such very poorly drained soils as Adrian, Edwards, Houghton, Martisco, Palms, and Wallkill drainage is not economically feasible. These soils are in depressional areas and potholes. Drainage ditches need to be deep and to extend for a great distance to reach a suitable outlet.

Unless artificially drained, the somewhat poorly drained soils are so wet that crops are damaged during most years. Crop damage results from late planting, root damage, and late harvest. Examples of this kind of soil are Brady, Conover, Haskins, Homer, and Nappanee soils.

Wawasee, Morley, and Rawson soils have good natural drainage most of the year, but they tend to dry out slowly after rains. Small areas of wetter soils along drainageways and in swales are commonly included in areas of these soils, especially those that have slopes of 2 to 6 percent. Spring seeps are present in places. Artificial drainage is needed in some of these wetter areas and in swales.

The design of surface and subsurface drainage systems varies as the kind of soil varies. A combination of surface drainage and tile drainage is needed in some areas of very poorly drained soils that are used for intensive row cropping. Drains have to be more closely spaced in soils that have slow permeability than in soils that are more permeable. Soils containing stratified material need special treatment for both tile drains and open ditches. Tile drainage is slow in Blount, Nappanee, and Pewamo soils. Finding adequate outlets for tile drainage is difficult in many areas of Blount, Nappanee, Pewamo, Palms, and Houghton soils and in certain other nearly level, depressional soils and muck soils.

Organic soils oxidize and subside when the pore space is filled with air; therefore, special drainage systems are needed to control the depth and the period of drainage. Keeping the water table at the level required by crops during the growing season and raising it to the surface during other times of the year minimize the oxidation and subsidence of organic soils. More emphasis needs to be placed on water level control in these soils. Information on drainage design for each kind of soil is available in the local office of the Soil Conservation Service.

Erosion is the main concern on about 30 percent of the cropland and pasture in Lagrange County. If slope is more than 2 percent, erosion is a hazard. In addition, soil blowing is a concern in several areas of the county that have a coarse textured surface layer.

Loss of the surface layer through erosion is damaging for two reasons. First, productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into the plow layer. Loss of the surface layer is especially damaging on soils that have a clayey subsoil, such as the Wawasee soils. Erosion also reduces productivity on soils that tend to be droughty, such as Boyer, Chelsea, and Plainfield soils. Second, erosion results in sediment entering streams. Control of erosion minimizes the pollution of streams by sediment and improves water quality for municipal use, for recreation, and for fish and wildlife.

In many sloping fields, preparing a good seedbed and tilling are difficult on severely eroded spots, because the original friable surface layer has eroded. Such spots are common in areas of eroded Wawasee soils.

Erosion control measures provide surface cover, reduce runoff, and increase infiltration. A cropping system that keeps plant cover on the soil for extended periods can hold soil erosion losses to amounts that do not reduce the productive capacity of the soils. On livestock farms, which require pasture and hay, the legume and grass forage crops in the cropping system reduce erosion on sloping land and also provide nitrogen and improve tilth for the crop that follows.

Slopes are so short and irregular that contour tillage and terracing are not commonly used on sloping soils in Lagrange County. On these soils, cropping systems that provide substantial plant cover are needed to control erosion. Also minimum tillage is important in controlling erosion. Minimizing tillage and leaving crop residue on the surface of the soil help increase infiltration and reduce the hazards of runoff and erosion. Minimum tillage can be adapted to most soils in the survey area; however, it is difficult to use successfully on the eroded soils that have a clayey subsoil and on soils that are very poorly drained or somewhat poorly drained, such as Blount, Nappanee, and Pewamo soils. No-tillage for

corn, which is being used in the county, can be adapted to most of the soils and is effective in reducing erosion on sloping land.

Diversions and parallel tile outlet terraces shorten the effective length of slope and are effective in reducing sheet, rill, and gully erosion. They are most practical on deep, well drained soils that are highly susceptible to erosion. The benefits of terracing are a reduction in soil loss and the associated loss of fertilizer elements; a reduction in sediment problems, such as crop damage and damage to water courses; and a reduction of the need for grassed waterways, which take productive land out of row crops. Terraces also make farming on the contour easier, which reduces the use of fuel and reduces the amount of pesticides entering water courses. Many of the Wawasee soils are suitable for terraces.

Grassed waterways are needed in many areas of Lagrange County on sloping soils, such as Wawasee and Hillsdale soils. In addition, many areas of nearly level soils, such as Blount and Brookston soils, need waterways or surface drains where a large watershed drains across these soils. Tile drainage is generally needed in waterways on Blount and Rensselaer soils. Many areas of Wawasee soils along drainageways are seepy, and tile needs to be installed in the drainageways.

Many open ditches are in the county, and grade stabilization structures are needed along some of these ditches. These structures help reduce erosion where surface water drains into the ditch. Also, structures are commonly needed in ditches where too much grade allows water to move so rapidly that erosion is a hazard on the sides and bottom of channels.

Soil blowing is a hazard in drained areas of Houghton and Palms soils. Soil blowing can damage these muck soils in a few hours if winds are strong and the soils are dry and bare of vegetation or surface mulch. Maintaining plant cover, surface mulch, or rough surfaces through proper tillage minimizes soil blowing. Windbreaks of adapted shrubs are effective in reducing soil blowing on the muck soils. Soil blowing also occurs on bare areas of mineral soils, especially the nearly level, coarse textured soils, such as Plainfield. Soils that are plowed in fall are very susceptible to soil blowing in the following spring.

Soil fertility is naturally low or moderate in most soils on uplands and terraces. Very poorly drained soils, such as Pewamo, Rensselaer, Houghton, and Palms soils, are in depressions and receive runoff from adjacent upland soils. They are generally slightly acid or neutral.

Strongly acid or medium acid soils need applications of ground limestone to raise the pH level and promote good growth of alfalfa and other crops that grow only on nearly neutral soils. On all soils, additions of lime and fertilizer should be based on the results of soil tests, on the need of the crop, and on the expected level of yields. The Cooperative Extension Service can help in determining the kinds and amounts of fertilizer and lime to apply.

Soil tilth is important in the germination of seeds and in the infiltration of water into the soil. Soils that have good tilth are granular and porous. Many of the soils in the survey area have a coarse textured surface layer and are porous.

Some of the soils in the survey area have a silt loam surface layer that has fair or poor tilth. Intense rainfall results in the formation of a crust on the surface of these soils. Once a hard crust forms, infiltration is reduced and runoff is increased. Regular additions of crop residue, manure, and other organic material help improve tilth and reduce crust formation.

Fall plowing is generally not a good practice in most areas of the county. About 40 percent of the cropland consists of sloping soils that are subject to damaging erosion if they are plowed in fall.

The dark colored, very poorly drained Pewamo soils and the somewhat poorly drained Blount and Nappanee soils have a clayey subsoil, and tilth is a problem because the soils commonly stay wet until late in spring. If plowed when wet, these soils tend to be very cloddy when dry, and a good seedbed is difficult to prepare. Fall plowing of these soils generally results in good tilth in spring.

Row crops that are suited to the soils and climate of the survey area are corn and soybeans. Close-growing crops that are suited are wheat and oats.

Special crops are of limited commercial importance in the survey area. Only a small acreage is used for vegetables and small fruits. Deep soils that have good natural drainage and that warm up early in spring are especially well suited to many vegetables and small fruits. Examples of such soils are Wawasee, Boyer, and Oshtemo. Boyer and Oshtemo soils need to be irrigated for optimum production. Crops can generally be planted and harvested early on all these soils because of their good drainage and because they warm up quickly.

When adequately drained, the muck soils are well suited to a wide range of vegetable crops. Several areas of Houghton and other muck soils are suitable for this purpose.

Most of the well drained soils in the survey area are suitable for orchards and nursery plants. Soils in low positions where frost is frequent and air drainage is poor, however, generally are poorly suited to early vegetables, small fruits, and orchards. Some areas of muck soils are well suited to blueberries.

Latest information and suggestions for growing special crops can be obtained from local offices of the Cooperative Extension Service and the Soil Conservation Service.

Yields per acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 6. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension

agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green-manure crops; and harvesting that insures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 6 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils.

Land capability classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey. These levels are defined in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have slight limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, woodland, wildlife habitat, or recreation.

Capability units are soil groups within a subclass. The soils in a capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-4 or IIIe-6.

The acreage of soils in each capability class and subclass is shown in table 7. The capability classification of each map unit is given in the section "Soil maps for detailed planning."

Woodland management and productivity

Ed Stuff, District conservationist, Soil Conservation Service, assisted in the preparation of this section.

Lagrange County has 21,815 acres of woodland. Originally vast areas in the county were forested, but most of these areas have been cleared. Those remaining cover approximately 9 percent of the county. Many of the remaining tracts of timber are in areas that are too erodible, wet, or droughty to farm.

Changes in farming operations, equipment, and economics threaten to further reduce the timber acreage within the county. Most of the soils in the county are suitable for some kind of timber production. Each soil, however, differs in properties that affect tree growth. Information given in this soil survey can be used to

select trees adapted to a particular field and can be helpful in indentifying soils which will potentially provide a good economic return from woodland.

Table 8 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. The table lists the ordination (woodland suitability) symbol for each soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for important trees. The number 1 indicates very high productivity; 2, high; 3, moderately high; 4, moderate; and 5, low. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *x* indicates stoniness or rockiness; *w*, excessive water in or on the soil; *t*, toxic substances in the soil; *d*, restricted root depth; *c*, clay in the upper part of the soil; *s*, sandy texture; *f*, high content of coarse fragments in the soil profile; and *r*, steep slopes. The letter *o* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: x, w, t, d, c, s, f, and r.

In table 8, *slight, moderate,* and *severe* indicate the degree of the major soil limitations to be considered in management.

Ratings of the *erosion hazard* indicate the risk of loss of soil in well managed woodland. The risk is *slight* if the expected soil loss is small, *moderate* if measures are needed to control erosion during logging and road construction, and *severe* if intensive management or special equipment and methods are needed to prevent excessive loss of soil.

Ratings of *equipment limitation* reflect the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. A rating of *slight* indicates that use of equipment is not limited to a particular kind of equipment or time of year; *moderate* indicates a short seasonal limitation or a need for some modification in management or in equipment; and *severe* indicates a seasonal limitation, a need for special equipment or management, or a hazard in the use of equipment.

Seedling mortality ratings indicate the degree to which the soil affects the mortality of tree seedlings. Plant competition is not considered in the ratings. The ratings apply to seedlings from good stock that are properly planted during a period of sufficient rainfall. A rating of *slight* indicates that the expected mortality is less than 25 percent; *moderate*, 25 to 50 percent; and *severe*, more than 50 percent.

Ratings of *windthrow hazard* are based on soil characteristics that affect the development of tree roots and the ability of the soil to hold trees firmly. A rating of *slight* indicates that a few trees may be blown down by normal winds; *moderate*, that some trees will be blown down during periods of excessive soil wetness and strong winds; and *severe*, that many trees are blown down during periods of excessive soil wetness and moderate or strong winds.

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index*. This index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. Commonly grown trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

Trees to plant are those that are suited to the soils and to commercial wood production.

Windbreaks and environmental plantings

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, hold snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To insure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 9 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 9 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a nursery.

Recreation

Ed Stuff, District conservationist, Soil Conservation Service, assisted in the preparation of this section.

Recreation is a growing industry in Lagrange County. The water resources and scenic areas in the county plus proximity of the county to metropolitan areas have led to considerable interest in recreation such as water skiing, fishing, canoeing, camping, picnicking, and other outdoor activities. The soils information in this survey can be helpful in selecting areas that are suitable for developing outdoor recreation.

The soils of the survey area are rated in table 10 according to limitations that affect their suitability for

recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 10, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 10 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 13 and interpretations for dwellings without basements and for local roads and streets in table 12.

Camp areas require site preparation such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking, horseback riding, and bicycling should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Wildlife habitat

Ed Stuff, District conservationist, Soil Conservation Service, assisted in the preparation of this section.

Areas of good quality wildlife habitat are around the many lakes and along the streams and rivers in Lagrange County. Several wetland and marsh areas are present that provide habitat for aquatic animals and waterfowl. Fence rows, woodland, and other types of cover provide habitat for many kinds of wildlife. Deer, rabbit, pheasant, quail, squirrel, muskrat, and many other animal species are common in the county.

This soil survey can be very useful in identifying specific areas for wildlife habitat. Many areas within the county can be developed or improved for wildlife. The wide range of soils, topography, and plant cover in Lagrange County contribute to a high potential for various kinds of wildlife.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 11, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, grain sorghum, and soybeans.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are orchardgrass, bromegrass, fescue, timothy, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are goldenrod, beggarweed, pokeweed, giant ragweed, pigweed, and smartweed.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, the available water capacity, and wetness. Examples of these plants are oak, poplar, black cherry, elm, maple, apple, hawthorn, dogwood, hickory, blackberry, and blueberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian-olive, autumn-olive, and crabapple.

Coniferous plants furnish browse, seeds, and cones. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, fir, tamarack, cedar, and juniper.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, pondweed, spikerush, wild millet, wildrice, duckweed, cordgrass, rushes, sedges, reeds, and cattail.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include bobwhite quail, dove, pheasant, meadowlark, field sparrow, cottontail, red fox, and woodchuck.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, ruffed grouse, woodcock, thrushes, woodpeckers, squirrels, gray fox, raccoon, deer, and opossum.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, and beaver.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds

of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building site development

Table 12 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

Sanitary facilities

Table 13 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 13 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the

soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to effectively filter the effluent. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 13 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 13 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction materials

Table 14 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 14, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water management

Table 15 gives information on the soil properties and site features that affect water management. The kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; and aquifer-fed ponds.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Aquifer-fed excavated ponds are pits or dugouts that extend to a ground-water aquifer or to a depth below a

permanent water table. Excluded are ponds that are fed only by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Excavated ponds are affected by depth to a permanent water table, permeability of the aquifer, and quality of the water as inferred from the salinity of the soil. Depth to bedrock and the content of large stones affect the ease of excavation.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering index properties

Table 16 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil series and morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains particles coarser than sand, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (*1*).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as Pt. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-

5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments more than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an oven-dry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and chemical properties

Table 17 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion and the amount of soil lost. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to wind erosion.

Soil and water features

Table 18 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams and by runoff from adjacent slopes. Water standing for short periods after rainfall or snowmelt and water in swamps and marshes is not considered flooding.

Table 18 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered is local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 18 are the depth to the seasonal high water table; the kind of water table—that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 18.

An apparent water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. An artesian water table is under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole. A perched water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Classification of the soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*5*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. In table 19, the soils of the survey area are classified according to the system. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Alfisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Udalfs (*Ud*, meaning humid, plus *alf*, from Alfisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Hapludalfs (*Hapl*, meaning minimal horizonation, plus *udalf*, the suborder of the Alfisols that have a udic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Hapludalfs.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-loamy, mixed, mesic Typic Hapludalfs.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Soil series and morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the Soil Survey Manual (*4*). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (*5*). Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Soil maps for detailed planning."

Adrian series

The Adrian series consists of very poorly drained soils in depressional areas on outwash plains, till plains, and moraines. These soils formed in organic material overlying sandy mineral deposits. Permeability is moderately slow to moderately rapid in the solum and rapid in the underlying material. Slope ranges from 0 to 2 percent.

Adrian soils are similar to Edwards, Houghton, Martisco, and Palms soils. Edwards and Martisco soils are underlain with marl. Houghton soils have a much thicker organic layer. Palms soils are underlain with loamy material.

Typical pedon of Adrian muck, in an undrained area, 2,500 feet west and 1,400 feet north of the southeast corner of sec. 6, T. 37 N., R. 11 E.

Oa1—0 to 14 inches; black (N 2/0) sapric material, broken face and rubbed; 10 percent fiber, less than 5 percent rubbed; moderate medium granular structure; friable; many fine roots; 10 percent mineral content; neutral; abrupt wavy boundary.

Oa2—14 to 25 inches; black (5YR 2/1) sapric material, broken face and rubbed; 10 percent fiber, less than 5 percent rubbed; weak coarse subangular blocky structure; friable; many fine roots; 20 percent mineral content; neutral; abrupt smooth boundary.

IIC—25 to 60 inches; gray (10YR 5/1) sand; single grain; loose; strong effervescence; moderately alkaline.

The organic layer ranges from 16 to 50 inches in thickness. It is derived mainly from herbaceous plants.

The Oa1 horizon is black (10YR 2/1, N 2/0). The organic part of the subsurface and bottom tiers has hue of 10YR, 7.5YR, or 5YR, value of 2 or 3, and chroma of 1 to 3 or has hue of N and value of 2 or 3. The organic layers are medium acid to mildly alkaline. The IIC horizon is sand, loamy sand, gravelly sand, or gravelly loamy sand. It is slightly acid to moderately alkaline and, in some pedons, contains free carbonates.

Blount series

The Blount series consists of deep, somewhat poorly drained, slowly permeable soils on glacial till plains. These soils formed in glacial till. Slope ranges from 0 to 3 percent.

Blount soils are similar to Conover, Haskins and Nappanee soils and are commonly adjacent to Morley and Rawson soils. Conover soils have less clay in the B horizon than Blount soils. Haskins soils have less clay in the A horizon and upper part of the B horizon. Nappanee soils have a higher percentage of clay in the solum. Morley and Rawson soils are on higher positions in the landscape and have brighter colors throughout the solum. Rawson soils have more sand and less clay in the A horizon and upper part of the B horizon.

Typical pedon of Blount silt loam, 0 to 3 percent slopes, in a cultivated field, 400 feet south and 300 feet east of the center of sec. 20, T. 36 N., R. 8 E.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; moderate medium granular structure; friable; many medium roots; slightly acid; abrupt smooth boundary.

A2—9 to 12 inches; grayish brown (10YR 5/2) silt loam; moderate medium platy structure parting to moderate medium granular; friable; many medium roots; medium acid; clear smooth boundary.

B21t—12 to 17 inches; yellowish brown (10YR 5/6) clay loam; many medium distinct grayish brown (10YR 5/2) mottles; strong fine and medium angular blocky structure; firm; thin continuous dark grayish brown (10YR 4/2) clay films on faces of peds; strongly acid; gradual wavy boundary.

B22t—17 to 27 inches; yellowish brown (10YR 5/6) silty clay; many medium distinct grayish brown (2.5Y 5/2) mottles; strong medium distinct grayish brown (2.5Y 5/2) mottles; strong medium angular blocky structure; firm; thin continuous dark gray (10YR 4/1) clay films on faces of peds and very dark gray (10YR 3/1) organic coatings lining voids; slightly acid; gradual wavy boundary.

C—27 to 60 inches; yellowish brown (10YR 5/4) clay loam; many fine distinct light olive gray (5Y 6/2) mottles; massive; firm; 2 percent gravel; strong effervescence; moderately alkaline.

The solum commonly is 24 to 36 inches thick.

The Ap horizon is dark gray (10YR 4/1) or dark grayish brown (10YR 4/2). The B horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 6, and is mottled. It is silty clay loam, clay loam, clay or silty clay. Reaction ranges from medium acid to very strongly acid in the B21t horizon and from medium acid to moderately alkaline in the B22t horizon. The C horizon ranges from silty clay loam to clay loam.

Boyer series

The Boyer series consists of well drained soils on outwash plains and in morainic areas. These soils formed in loamy outwash overlying sand and gravel. They are moderately deep over the sand and gravel. Permeability is moderately rapid in the subsoil and very rapid in the underlying material. Slope ranges from 0 to 18 percent.

Boyer soils are similar to Chelsea and Oshtemo soils. These soils have a thicker solum than Boyer soils, and Chelsea soils have higher sand content in the solum.

Typical pedon of Boyer loamy sand, 0 to 2 percent slopes, in a cultivated field, 2,500 feet south and 500 feet east of the center of sec. 20, T. 38 N., R. 9 E.

Ap—0 to 10 inches; dark grayish brown (10YR 4/2) loamy sand, pale brown (10YR 6/3) dry; weak fine granular structure; friable; many fine roots; 5 percent gravel; slightly acid; abrupt smooth boundary.

B1—10 to 18 inches; dark yellowish brown (10YR 4/4) loamy sand; weak fine subangular blocky structure; friable; many fine roots; 5 percent gravel; slightly acid; clear smooth boundary.

B21t—18 to 25 inches; brown (7.5YR 4/4) sandy loam; weak fine and medium subangular blocky structure; friable; few fine roots; thin patchy dark brown (10YR 4/3) clay films on faces of peds and bridging sand grains; 5 percent gravel; medium acid; abrupt wavy boundary.

B22t—25 to 33 inches; dark yellowish brown (10YR 4/4) sandy loam; weak fine and medium subangular blocky structure; friable; thin discontinuous dark brown (10YR 4/3) clay films on faces of peds and bridging sand grains; 8 percent gravel; slightly acid; abrupt wavy boundary.

B23t—33 to 36 inches; dark yellowish brown (10YR 4/4) loamy sand; weak fine subangular blocky structure; friable; thin patchy dark brown (10YR 4/3) clay films bridging sand grains; 8 percent gravel; neutral; abrupt irregular boundary.

IIC—36 to 60 inches; brown (10YR 5/3) stratified sand and gravelly sand; single grain; loose; strong effervescence; moderately alkaline.

The solum is 22 to 40 inches thick. It corresponds in thickness to the depth to calcareous sand and gravel.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. The A2 horizon, where present, has hue of 10YR, value of 5 or 6, and chroma of 3 or 4. The A horizon is loamy sand or sandy loam. The B2 horizon has hue of 10YR, 7.5YR, or 5YR, value of 3 to 6, and chroma of 3 to 6. The B2 horizon is sandy loam, gravelly sandy loam, sandy clay loam, or gravelly clay loam. Tongues of material from the B23 horizon extend as much as 12 inches into the IIC material in some pedons. The IIC horizon has hue of 10YR, value of 5 or 6, and chroma of 2, 3, or 4. The IIC horizon is stratified coarse sand and gravelly sand.

Brady series

The Brady series consists of deep, somewhat poorly drained soils on broad, nearly level outwash plains. These soils formed in glacial outwash. Permeability is moderately rapid in the upper part of the solum, rapid in the lower part of the solum, and very rapid in the underlying material. Slope ranges from 0 to 2 percent.

Brady soils are similar to Homer and Whitaker soils and are commonly near Bronson soils. Homer soils have more clay in the B horizon than Brady soils and have a lighter colored A horizon. Whitaker soils have more clay throughout the profile. Bronson soils are on slightly higher positions in the landscape, have brighter colors in the upper part of the profile, and are moderately well drained.

Typical pedon of Brady sandy loam, in a cultivated field, 1,800 feet east and 2,000 feet south of the northwest corner of Sec. 32, T. 37 N., R. 8 E.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) sandy loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; many medium roots; 5 percent fine gravel; slightly acid; abrupt smooth boundary.

B21—9 to 12 inches; brown (10YR 4/3) loamy sand; weak fine subangular blocky structure; friable; many medium roots; 10 percent gravel; slightly acid; clear smooth boundary.

B21t—12 to 36 inches; brown (10YR 5/3) sandy loam; common fine distinct strong brown (7.5YR 5/6) and light brownish gray (10YR 6/2) mottles; weak fine subangular blocky structure; friable; common fine roots; thin patchy dark grayish brown (10YR 4/2) clay films on faces of peds and bridging between sand grains; 10 percent gravel; slightly acid; clear smooth boundary.

B22t—36 to 42 inches; yellowish brown (10YR 5/6) sandy clay loam; common fine distinct strong brown (7.5YR 5/6) and light brownish gray (10YR 6/2) mottles; moderate medium subangular blocky structure; firm; few fine roots; thin patchy dark grayish brown (10YR 4/2) clay films on faces of peds; 5 percent gravel; medium acid; clear smooth boundary.

B23g—42 to 53 inches; grayish brown (10YR 5/2) sandy loam; common medium distinct yellowish brown (10YR 5/8) mottles; weak fine subangular blocky structure; friable; 5 percent gravel; medium acid; clear smooth boundary.

IIC—53 to 60 inches; brown (10YR 5/3) coarse sand and gravelly sand; single grain; loose; strong effervescence; moderately alkaline.

The solum ranges from 40 to 70 inches in thickness. Reaction throughout the solum is slightly acid to strongly acid.

The Ap horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2). The A2 horizon, where

present, is sandy loam or loamy sand. The B21 horizon is brown (10YR 5/3) or pale brown (10YR 6/3) and is sandy loam or gravelly sandy loam. The B22t horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. It is sandy clay loam, sandy loam, gravelly sandy loam or gravelly sandy clay loam. The B23 horizon is grayish brown (10YR 5/2), light brownish gray (10YR 6/2), pale brown (10YR 6/3), brown (10YR 5/3), or yellowish brown (10YR 5/4) sandy loam or loamy sand. The IIC horizon is grayish brown (10YR 5/2), brown (10YR 5/3), or gray (10YR 5/1) stratified coarse sand and fine gravelly sand.

Brems series

The Brems series consists of deep, moderately well drained, rapidly permeable soils on outwash plains. These soils formed in outwash deposits. Slope ranges from 0 to 3 percent.

Brems soils are similar to Bronson soils and are commonly adjacent to Plainfield soils. Bronson soils have more clay in the B horizon than Brems soils. Plainfield soils are excessively drained and are on higher lying positions in the landscape and have brighter colors throughout the profile.

Typical pedon of Brems sand, 0 to 3 percent slopes, in a cultivated field, 2,250 feet east and 1,000 feet south of the northwest corner of Sec. 9, T. 37 N., R. 11 E.

Ap—0 to 7 inches; dark brown (10YR 3/3) sand, light brownish gray (10YR 6/2) dry; weak fine granular structure; very friable; many fine roots; 2 percent fine gravel; slightly acid; abrupt smooth boundary.

A2—7 to 13 inches; yellowish brown (10YR 5/6) sand; weak fine granular structure; very friable; many fine roots; 10 percent fine gravel; root channels filled with dark brown (10YR 3/3) sand; slightly acid; clear wavy boundary.

B21—13 to 26 inches; yellowish brown (10YR 5/8) sand; weak fine granular structure; very friable; 10 percent fine gravel; medium acid; clear wavy boundary.

B22—26 to 31 inches; light yellowish brown (10YR 6/4) sand; few fine distinct yellowish brown (10YR 5/6) mottles; weak fine granular structure; very friable; 7 percent fine gravel; medium acid; gradual irregular boundary.

B23—31 to 40 inches; brown (10YR 5/3) sand; common medium distinct light brownish gray (10YR 6/2) mottles; single grain; loose; 10 percent fine gravel; medium acid; gradual wavy boundary.

B3—40 to 50 inches; yellowish brown (10YR 5/8) sand; common medium distinct light brownish gray (10YR 6/2) mottles; single grain; loose; 10 percent fine gravel; medium acid; gradual wavy boundary.

C1—50 to 55 inches; pale brown (10YR 6/3) fine sand; common medium distinct light brownish gray (10YR 6/2) mottles; single grain; loose; 5 percent fine gravel; medium acid; gradual wavy boundary.

C2—55 to 60 inches; yellowish brown (10YR 5/4) fine sand; common medium distinct light brownish gray (10YR 6/2) mottles; single grain; loose; 5 percent fine gravel; medium acid.

The solum ranges from 35 to 70 inches in thickness.

The Ap horizon has hue of 10YR, value of 3 to 5, and chroma of 2 or 3. It is sand and is slightly acid to strongly acid. The B2 horizon has hue of 10YR or 7.5YR, value of 5 or 6, chroma of 3 to 8. It is loamy sand or sand and is medium acid to very strongly acid. This horizon has mottles with chroma of 2 or less at a depth between about 20 and 36 inches. The C horizon is typically medium or fine sand to a depth of 60 inches or more.

Bronson series

The Bronson series consists of deep, moderately well drained soils on outwash plains, valley trains, and low moraines. These soils formed in glacial outwash. Permeability is moderately rapid in the upper part of the solum and rapid in the lower part. Slope ranges from 0 to 3 percent.

Bronson soils are similar to Brems soils and are near Brady and Oshtemo soils. Brems soils have less clay in the solum than Bronson soils. Brady soils have low chroma mottles higher in the profile and are on lower lying positions. Oshtemo soils are on higher lying positions and do not have low chroma mottles within the control section.

Typical pedon of Bronson sandy loam, 0 to 3 percent slopes, in a cultivated field, 1,500 feet north and 200 feet west of the southeast corner of Sec. 32, T. 37 N., R. 8 E.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) sandy loam, light brownish gray (10YR 6/2) dry; weak fine granular structure; friable; many fine roots; neutral; abrupt smooth boundary.

A12—9 to 14 inches; yellowish brown (10YR 5/4) sandy loam; weak fine subangular blocky structure; friable; many fine roots; slightly acid; clear wavy boundary.

A2—14 to 20 inches; strong brown (7.5YR 5/6) loamy sand; weak fine subangular blocky structure; friable; common fine roots; slightly acid; clear wavy boundary.

B21t—20 to 27 inches; brown (7.5YR 4/4) gravelly sandy loam; few fine distinct brown (10YR 5/3) mottles; weak fine subangular blocky structure; friable; common fine roots; thin discontinuous dark brown (7.5YR 4/2) clay films on faces of peds and as bridging between sand grains; medium acid; clear wavy boundary.

B22t—27 to 37 inches; yellowish brown (10YR 5/4) sandy loam; few fine distinct grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; friable; few roots;

thin patchy dark brown (7.5YR 4/2) clay films on faces of peds and as bridging between sand grains; medium acid; clear wavy boundary.

B23t—37 to 47 inches; dark brown (10YR 4/3) loamy sand; few fine distinct grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; friable; thin discontinuous dark brown (7.5YR 4/2) clay films on faces of peds and as bridging between sand grains; medium acid; clear wavy boundary.

B3t—47 to 62 inches; dark brown (7.5YR 4/4) sandy loam; common medium distinct grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; friable; discontinuous dark brown (7.5YR 4/2) clay films on faces of peds and as bridging between sand grains; medium acid; clear wavy boundary.

IIC—62 to 74 inches; brown (10YR 5/3) gravelly sand; single grain; loose; strong effervescence; moderately alkaline.

The solum ranges from 40 to 70 inches in thickness.

The Ap horizon ranges from dark grayish brown (10YR 4/2) to brown (10YR 5/3). The A2 horizon is brown (7.5YR 5/6) to yellowish brown (10YR 5/4) sandy loam or loamy sand. The A horizon is neutral to strongly acid. The B2t horizon has hue of 10YR or 7.5YR, value of 4 or 5 and chroma of 3 or 4. It is medium acid or strongly acid. The B3 horizon is dark brown (10YR 4/3 or 7.5YR 4/4) sandy loam, loamy sand, or gravelly loamy sand. It is strongly acid to neutral. The IIC horizon is grayish brown (10YR 5/2) or brown (10YR 5/3) gravelly sand or coarse sand and gravelly sand.

Chelsea series

The Chelsea series consists of deep, excessively drained, rapidly permeable soils on outwash plains, valley trains, and moraines. These soils formed in wind- or water-deposited sand or in outwash deposits. Slope ranges from 1 to 12 percent.

Chelsea soils are similar to the Hillsdale, Metea, Oshtemo, and Plainfield soils. Hillsdale soils have more clay in the B horizon than Chelsea soils and are underlain with sandy loam or loamy sand till. Metea soils have more clay in the lower part of the B horizon and in the C horizon. Oshtemo soils have more clay in the B horizon and have a gravelly sand substratum. Plainfield soils do not have loamy sand bands above a depth of 60 inches.

Typical pedon of Chelsea fine sand, 1 to 6 percent slopes, in a cultivated field, 400 feet east and 650 feet north of the southwest corner of Sec. 33, T. 38 N., R. 11 E.

Ap—0 to 10 inches; brown (10YR 4/3) fine sand, light brownish gray (10YR 6/2) dry; weak fine granular structure; very friable; common roots; neutral; abrupt smooth boundary.

A21—10 to 13 inches; yellowish brown (10YR 5/4) fine sand; weak fine granular structure; very friable; neutral; clear smooth boundary.

A22—13 to 36 inches; yellowish brown (10YR 5/4) sand; single grain; loose; neutral; gradual wavy boundary.

A&B—36 to 70 inches; yellowish brown (10YR 5/8) sand (A part); single grain; loose; bands of brown (7.5YR 4/4) loamy sand (B part); weak fine subangular block structure; very friable; bands are 1/4 to 3/4 inch thick at depths of 36, 40, 45, 48, 52, and 57 inches; bands have a cumulative thickness of about 4 inches; 2 percent fine gravel; medium acid; gradual smooth boundary.

C—70 to 80 inches; light yellowish brown (10YR 6/4) sand; single grain; loose; 2 percent fine gravel; slightly acid.

The solum ranges from 5 to 7 feet in thickness, and carbonates are not present within a depth of 60 inches.

In cultivated areas, the Ap horizon is dark grayish brown (10YR 4/2) or brown (10YR 4/3 or 3/3) sand or loamy sand. The A2 horizon has hue of 10YR, value of 4 to 6, and chroma of 2 to 4. It is fine sand or sand. The A part of the A & B horizon is 1/4 inch to 2 inches thick. The B part of the A & B horizon is bands 1/4 inch to 2 inches thick. They have hue of 7.5YR or 10YR, value and chroma of 3 or 4, and are sandy loam or loamy sand. These bands have a cumulative thickness of 2 to 5 inches within a depth of 60 inches and are spaced 3 to 6 inches apart. These bands are typically below a depth of 30 inches, but range from as shallow as 26 inches to as deep as 48 inches to the first band.

Conover series

The Conover series consists of deep, somewhat poorly drained soils on glacial till plains on uplands. These soils formed in glacial till. Permeability is moderately slow. Slope ranges from 0 to 3 percent.

Conover soils are similar to Blount and Haskins soils and are commonly adjacent to Rensselaer and Wawasee soils. Blount soils contain more clay throughout the profile than Conover soils. Haskins soils contain more clay in the lower part of the B horizon, and in the C horizon, Rensselaer soils have a darker colored horizon, a grayer B horizon, and are very poorly drained, and are in depressional positions. Wawasee soils have a brighter colored profile, are well drained, and are on higher lying positions.

Typical pedon of Conover loam, 0 to 3 percent slopes, in a cultivated field, 700 feet east and 50 feet south of the northwest corner of Sec. 32, T. 36 N., R. 9 E.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; many roots; slightly acid; abrupt smooth boundary.

A2—9 to 13 inches; grayish brown (10YR 5/2) sandy loam; weak fine subangular blocky structure; friable; many roots; slightly acid; clear smooth boundary.

B1—13 to 16 inches; yellowish brown (10YR 5/4) sandy loam; few fine faint grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; friable; common roots; 2 percent gravel; slightly acid; gradual wavy boundary.

B21t—16 to 21 inches; grayish brown (10YR 5/2) clay loam; few fine faint yellowish brown (10YR 5/8) mottles; moderate medium subangular blocky structure; firm; common roots; thin continuous dark grayish brown (10YR 4/2) clay films on faces of peds; 2 percent gravel; medium acid; gradual wavy boundary.

B22t—21 to 32 inches; yellowish brown (10YR 5/4) clay loam; many medium faint yellowish brown (10YR 5/8) and common fine faint grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; few roots; thin continuous dark grayish brown (10YR 4/2) clay films on faces of peds; many medium black (10YR 2/1) iron and manganese oxide accumulations; 2 percent gravel; neutral; gradual wavy boundary.

B3t—32 to 36 inches; yellowish brown (10YR 5/4) loam; common medium faint (10YR 5/8) mottles; weak fine and medium subangular blocky structure; friable; few roots; thin patchy dark grayish brown (10YR 4/2) clay films on faces of peds; few medium black (10YR 2/1) iron and manganese oxide accumulations; 2 percent gravel; mildly alkaline; gradual wavy boundary.

C—36 to 60 inches; brown (10YR 5/3) loam; common medium distinct yellowish brown (10YR 5/6) mottles; massive; friable; few light grayish brown (10YR 6/2) streaks; strong effervescence; moderately alkaline.

The solum is 24 to 40 inches thick. The content of gravel ranges from 0 to 10 percent.

The Ap horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2) loam or sandy loam. The A2 horizon, where present, is grayish brown (10YR 5/2) or light brownish gray (10YR 6/2) loam or sandy loam. The B2t horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 2 to 4. It is mainly clay loam, but some subhorizons are silty clay loam or loam.

Edwards series

The Edwards series consists of very poorly drained soils in depressional areas on uplands and outwash plains. These soils formed in the remains of decomposed reeds, sedges, grasses, and water-tolerant trees and shrubs over marl. They are moderately deep or deep to the marl. Permeability is moderately slow to moderately rapid in the organic material and variable in the marl.

Edwards soils are similar to Adrian, Houghton, Martisco, and Palms soils. Adrian soils are underlain with sandy material. Houghton soils have a much deeper organic layer than Edwards soils. Martisco soils have less than 16 inches of organic deposits over marl. Palms soils are underlain with loamy material.

Typical pedon of Edwards muck, in pastureland, 1,800 feet south and 50 feet west of the northeast corner of Sec. 9, T. 36 N., R. 9 E.

Oa1—0 to 7 inches; black (N 2/0) sapric material, broken face and rubbed, about 5 percent fiber before and after rubbing; weak fine granular structure; friable; herbaceous fibers; many roots; slightly acid; abrupt smooth boundary.

Oa2—7 to 11 inches; black (N 2/0) sapric material, broken face and rubbed, about 5 percent fiber before and after rubbing; weak thin platy structure; friable; many roots; herbaceous fibers; slightly acid; abrupt smooth boundary.

Oa3—11 to 21 inches; black (N 2/0) sapric material, broken face and rubbed; about 5 percent fiber before and after rubbing; massive; friable; few roots; herbaceous fibers; neutral; clear smooth boundary.

Oa4—21 to 25 inches; dark reddish brown (5YR 2/2) sapric material, broken face and rubbed; about 5 percent fiber before and after rubbing; massive; friable; few roots; herbaceous fibers; neutral; clear smooth boundary.

Lca1—25 to 30 inches; grayish brown (10YR 5/2) marl; massive; friable; violent effervescence; moderately alkaline; gradual smooth boundary.

Lca2—30 to 60 inches; light gray (10YR 7/1) marl; massive; friable; violent effervescence; moderately alkaline.

The depth to the Lca horizon is dominantly 16 to 36 inches thick, but is as much as 49 inches in some pedons. The fiber is mainly derived from herbaceous plants. Reaction throughout the organic material typically is mildly alkaline but ranges to medium acid.

The surface tier is black (10YR 2/1, N 2/0), broken face and rubbed. The organic part of the subsurface layer and bottom tiers, broken face and rubbed, has hue of 10YR, 7.5YR, 5YR, value of 2 or 3, and chroma of 1 to 3, or it has hue of N and value of 2 or 3. The Lca horizon has hue of 10YR, value of 5 to 8, and chroma of 1 or 2.

Gilford series

The Gilford series consists of deep, very poorly drained soils on outwash plains. These soils formed in glacial outwash. Permeability is moderately rapid in the subsoil and rapid in the underlying material. Slope ranges from 0 to 2 percent.

Gilford soils are similar to Granby, Rensselaer, and Sebewa soils and are commonly adjacent to Brady soils. Granby soils have more sand in the solum than Gilford soils. Rensselaer and Sebewa soils have more clay in

the B horizon. Brady soils have a dark colored A horizon less than 10 inches thick, are in slightly higher positions, and are somewhat poorly drained.

Typical pedon of Gilford sandy loam, in a cultivated field, 1,050 feet south and 1,000 feet east of the northwest corner of sec. 25, T. 38 N., R. 8 E.

Ap—0 to 7 inches; black (10YR 2/1) sandy loam, gray (10YR 5/1) dry; weak fine granular structure; friable; many roots; 5 percent gravel; slightly acid; abrupt smooth boundary.

A12—7 to 12 inches; black (10YR 2/1) sandy loam; weak fine subangular blocky structure; friable; many roots; 5 percent gravel; slightly acid; gradual wavy boundary.

B21g—12 to 18 inches; gray (10YR 5/1) sandy loam; few fine distinct brown (7.5YR 4/4) and common medium distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; common roots; black (10YR 2/1) organic stains in roots and worm channels; 5 percent gravel; slightly acid; clear smooth boundary.

B22g—18 to 32 inches; dark gray (10YR 4/1) sandy loam; few fine faint yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; common roots; many iron stains; 5 percent gravel; slightly acid; clear smooth boundary.

B3g—32 to 36 inches; dark gray (10YR 4/1) sandy clay loam; few fine distinct (7.5YR 4/4) mottles; moderate medium subangular blocky structure; firm; few roots; 15 percent gravel; slightly acid; clear smooth boundary.

IIC1g—36 to 54 inches; dark gray (10YR 4/1) loamy sand; single grain; loose; 5 percent gravel; neutral; clear smooth boundary.

IIC2g—54 to 70 inches; dark gray (10YR 4/1) loamy sand; single grain; loose; 10 percent gravel; neutral; clear smooth boundary.

IIC3g—70 to 80 inches; dark grayish brown (10YR 4/2) coarse sand and fine gravelly sand; single grain; loose; slight effervescence; moderately alkaline.

The solum is dominantly 30 to 40 inches thick, but in some areas it is 20 inches. Reaction of the A horizon is slightly acid or neutral, and reaction of the B horizon is medium acid to neutral in the upper part and slightly acid or neutral in the lower part. The C horizon is neutral to moderately alkaline.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 to 3. The B2g horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 and 2. It is commonly sandy loam, but thin subhorizons range to loam, sandy clay loam, and loamy sand. The C horizon is loamy sand, sand, coarse sand, or gravelly sand and has thin strata of sandy loam, clay loam, or silt.

Granby series

The Granby series consists of deep, very poorly drained, rapidly permeable soils on outwash plains. These soils formed in sandy glaciofluvial deposits. They have rapid permeability. Slope ranges from 0 to 2 percent.

Granby soils are similar to Gilford, Rensselaer, and Sebewa soils and are commonly adjacent to Brems soils. Gilford soils have a solum that is predominantly sandy loam and are underlain with coarse sand and fine gravel. Rensselaer and Sebewa soils have a B horizon that is clay loam. Sebewa soils are underlain with coarse sand and fine gravel. Brems soils are on slightly higher positions than Granby soils, have brighter colors, and do not have low chroma mottles in the upper part of the profile.

Typical pedon of Granby loamy fine sand, in a field, 2,800 feet east and 500 feet south of the northwest corner, sec. 12, T. 37 N., R. 11 E.

Ap—0 to 8 inches; very dark brown (10YR 2/2) loamy fine sand, very dark gray (10YR 3/1) dry; weak fine granular structure; very friable; many roots; medium acid; abrupt smooth boundary.

A12—8 to 11 inches; very dark grayish brown (10YR 3/2) loamy fine sand; weak fine granular structure; very friable; many roots; slightly acid; clear smooth boundary.

Clg—11 to 22 inches; grayish brown (10YR 5/2) fine sand; many medium distinct yellowish brown (10YR 5/6) mottles; single grain; loose; few roots; some mixing of very dark grayish brown (10YR 3/2) material from the surface; slightly acid; gradual irregular boundary.

C2g—22 to 48 inches; dark grayish brown (10YR 4/2) fine sand; many fine and medium distinct yellowish brown (10YR 5/6) mottles; single grain; loose; few roots; slightly acid; clear smooth boundary.

C3g—48 to 60 inches; gray (10YR 5/1) fine sand; many fine and medium distinct yellowish brown (10YR 5/6) mottles; single grain; loose; neutral.

The solum is medium acid to neutral to a depth of about 40 inches and is neutral to moderately alkaline below a depth of 40 inches. The mollic epipedon ranges from 10 to 14 inches in thickness.

The A horizon is black (10YR 2/1), very dark brown (10YR 2/2), very dark grayish brown (10YR 3/2), very dark gray (10YR 3/2), or black (N 2/0) loamy fine sand, loamy sand, sand, or fine sand.

The C horizon has hue of 10YR, 2.5Y, or 5Y, value of 4 to 7, and chroma of 1 to 4. It is sand or fine sand.

Haskins series

The Haskins series consists of deep, somewhat poorly drained soils on uplands. These soils formed in glacial drift and the underlying glacial till. Permeability is moder-

ate in the upper part of the solum and slow or very slow in the lower part and in the underlying material. Slope ranges from 0 to 3 percent.

Haskins soils are similar to Conover and Blount soils and are commonly adjacent to Morley, Pewamo, and Rawson soils. Conover soils contain less clay in the lower part of the B horizon and in the C horizon than Haskins soils. Blount soils contain more clay in the upper part of the B horizon. Morley soils contain more clay in the upper part of the B horizon, have a brighter colored solum, are moderately well drained, and are on higher lying positions. Pewamo soils have a darker colored A horizon and a grayer colored B horizon, are very poorly drained, and are in depressional positions. Rawson soils have a brighter colored solum, are moderately well drained or well drained, and are on higher lying positions.

Typical pedon of Haskins loam, 0 to 3 percent slopes, in a cultivated field, 500 feet south and 500 feet west of the center of sec. 20, T. 36 N., R. 8 E.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) loam, light brownish gray (10YR 6/2) dry; weak fine and medium granular structure; friable; common roots; neutral; abrupt smooth boundary.

A2g—8 to 13 inches; light brownish gray (10YR 6/2) loam; few fine distinct yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; friable; common roots; slightly acid; clear smooth boundary.

B21tg—13 to 20 inches; grayish brown (10YR 5/2) sandy clay loam; common medium distinct (10YR 5/6) mottles; moderate medium subangular blocky structure; friable; common roots; medium acid; clear wavy boundary.

B22t—20 to 35 inches; light olive brown (2.5Y 5/4) sandy clay loam; common medium distinct light brownish gray (10YR 6/2) mottles; moderate fine angular blocky structure; firm; common roots; thin to thick continuous dark grayish brown (10YR 4/2) clay films on faces of peds; medium acid; gradual wavy boundary.

IIB23t—35 to 42 inches; brown (10YR 5/3) clay; common medium distinct brownish yellow (10YR 6/6) mottles; moderate medium angular blocky structure; firm; thin continuous dark grayish brown (10YR 4/2) clay films on faces of peds; 2 percent gravel; neutral; clear wavy boundary.

IIC—42 to 60 inches; yellowish brown (10YR 5/4) clay; common medium distinct pale brown (10YR 6/3) mottles; massive; very firm; strong effervescence; moderately alkaline.

The solum is 26 to 42 inches thick and typically extends into the underlying fine textured material.

The Ap horizon is dark grayish brown (10YR 4/2). The A2 horizon is absent in some pedons. The B2t horizon has hue of 10YR and 2.5Y, value of 4 or 5, and chroma from 2 to 4. The A2 horizon is mottled dominantly clay loam or sandy clay loam. The IIB horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 or 3. It is clay, silty clay, clay loam, or silty clay loam. The IIC horizon is silty clay, clay loam, or clay.

Hillsdale series

The Hillsdale series consists of deep, well drained, moderately permeable soils on till plains and moraines. These soils formed in partially sorted and stratified glacial till. Slope ranges from 0 to 12 percent.

Hillsdale soils are similar to Metea and Oshtemo soils. Metea soils have more sand in the upper part of the horizon than Hillsdale soils. Oshtemo soils are underlain with sand and gravel.

Typical pedon of Hillsdale sandy loam, 2 to 6 percent slopes, in a cultivated field, 500 feet south and 1,500 feet west of the northeast corner sec. 13, T. 38 N., R. 10 E.

Ap—0 to 10 inches; dark brown (10YR 3/3) sandy loam, light brownish gray (10YR 6/2) dry; moderate fine granular structure; friable; many roots; slightly acid; abrupt smooth boundary.

A2—10 to 13 inches; brown (10YR 5/3) sandy loam; thin platy structure; friable; common roots; slightly acid; clear smooth boundary.

B1—13 to 17 inches; yellowish brown (10YR 5/4) sandy loam; moderate fine subangular blocky structure; friable; common roots; strongly acid; clear smooth boundary.

B21t—17 to 35 inches; dark yellowish brown (10YR 4/4) sandy loam; moderate medium subangular blocky structure; friable; common roots; thin reddish brown (5YR 4/4) clay films on some faces of peds; patchy black (10YR 2/1) organic accumulations on some faces of peds; 5 percent gravel; strongly acid; gradual wavy boundary.

B22t—35 to 41 inches; strong brown (7.5YR 5/6) sandy loam; moderate fine subangular blocky structure; friable; few roots; thin reddish brown (5YR 4/4) clay films on some faces of peds; patchy black (10YR 2/1) organic accumulations on some faces of peds; 5 percent gravel; strongly acid; gradual wavy boundary.

B23t—41 to 50 inches; yellowish brown (10YR 5/6) sandy loam; moderate fine subangular blocky structure; friable; thin brown (7.5YR 4/4) clay films on some faces of peds; 5 percent gravel; strongly acid; gradual wavy boundary.

B3—50 to 70 inches; brown (10YR 4/3) loamy sand; weak fine subangular blocky structure; friable; strongly acid; gradual wavy boundary.

C—70 to 80 inches; yellowish brown (10YR 5/4) loamy sand; massive; friable; 5 percent gravel; strong effervescence; moderately alkaline.

The solum ranges from 40 to 85 inches in thickness and corresponds to the depth to free carbonates. It ranges from slightly acid to very strongly acid but is typically medium acid to strongly acid. The Ap horizon is neutral in some areas.

The Ap horizon is very dark grayish brown (10YR 3/2), dark grayish brown (10YR 4/2), dark gray (10YR 4/1), or dark brown (10YR 3/3) sandy loam or loamy sand. The A2 horizon is brown (10YR 5/3) to pale brown (10YR 6/3) loamy sand, sandy loam, or loam. The B1 horizon is brown (10YR 5/3) or yellowish brown (10YR 5/4). The B2t horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3, 4, or 6. It is sandy loam, heavy sandy loam, light sandy clay loam, or loam. The B3 horizon is brown (10YR 5/3), yellowish brown (10YR 5/4), or dark brown (10YR 4/3) sandy loam or loamy sand. The C horizon is brown (10YR 5/3), yellowish brown (10YR 5/4), or light yellowish brown (10YR 6/4) sandy loam or loamy sand. It has pockets of sand in some pedons.

Homer series

The Homer series consists of somewhat poorly drained soils in outwash areas. These soils formed in glacial outwash. They are moderately deep over sand and gravel. Permeability is moderate in the solum and very rapid in the underlying material. Slope ranges from 0 to 2 percent.

Homer soils are similar to Brady and Whitaker soils. Brady soils are coarser textured and have a thicker solum than Homer soils. Whitaker soils have a finer textured C horizon.

Typical pedon of Homer sandy loam, in a cultivated field, 2,250 feet east and 200 feet south of the southwest corner of sec. 5, T. 36 N. R. 9 E.

Ap—0 to 8 inches; dark brown (10YR 3/3) sandy loam, light brownish gray (10YR 6/2) dry; weak fine granular structure; friable; many roots; 5 percent gravel; slightly acid; abrupt smooth boundary.

B1t—8 to 12 inches; brown (10YR 5/3) sandy clay loam; few fine distinct yellowish brown (10YR 5/6) and few fine faint grayish brown (10YR 5/2) mottles; weak fine subangular blocky structure; friable; many roots; few patchy dark grayish brown (10YR 4/2) clay films on faces of peds; few very dark grayish brown (10YR 3/2) organic stains; 5 percent gravel; medium acid; clear smooth boundary.

B21t—12 to 16 inches; brown (10YR 4/3) clay loam; common medium distinct yellowish brown (10YR 5/6) and grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; common roots; thin continuous dark grayish brown (10YR 4/2) clay films on faces of peds; few very dark grayish brown (10YR 3/2) organic stains; few black (10YR 2/1) iron and manganese oxide accumulations; 10 percent gravel; medium acid; clear wavy boundary.

B22t—16 to 30 inches; brown (10YR 4/3) gravelly clay loam; many medium distinct yellowish brown (10YR 5/6) and few fine distinct grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; few roots; thin continuous dark grayish brown (10YR 4/2) clay films on faces of peds; few very dark grayish brown (10YR 3/2) organic coatings on faces of some peds; few black (10YR 2/1) iron and manganese oxide accumulations; medium acid grading to neutral in lower part; abrupt irregular boundary.

IIC—30 to 60 inches; yellowish brown (10YR 5/4) stratified coarse sand and gravelly sand; single grain; loose; strong effervescence; mdoerately alkaline.

The solum ranges from 24 to 40 inches in thickness and corresponds to the depth to calcareous, stratified sand and gravel.

The Ap horizon has hue of 10YR, value of 3 to 5, chroma of 1 to 3. It is neutral to medium acid. The A2 horizon, where present, has hue of 10YR or 2.5Y, value of 4 or 5, chroma of 2 or 3. It is mottled in some pedons. This horizon is loam or sandy loam and is neutral to strongly acid. The Bt horizon has hue of 10YR or 2.5Y, value of 4 to 6, chroma of 1 to 4. This horizon is sandy loam, clay loam, gravelly clay loam, sandy clay loam, or loam and is medium acid or strongly acid in the most acid part.

Houghton series

The Houghton series consists of deep, very poorly drained soils in depressional areas on uplands and outwash plains. These soils formed almost completely in deep deposits of decomposed plant remains. Permeability is moderately slow to moderately rapid. Slope ranges from 0 to 2 percent.

Houghton soils are similar to Adrian, Edwards, Martisco, and Palms soils. Adrian soils are underlain with sandy material. Edwards and Martisco soils are underlain with marl. Palms soils are underlain with loamy material.

Typical pedon of Houghton muck, drained, in a pasture, 1,600 feet south and 1,000 feet west of the northeast corner of sec. 23, T. 36 N., R. 6 E.

Oa1—0 to 9 inches; black (N 2/0) sapric material, broken face and rubbed; about 10 percent fiber, less than 5 percent rubbed; weak medium granular structure; friable; many roots; neutral; abrupt smooth boundary.

Oa2—9 to 23 inches; dark reddish brown (5YR 3/2) sapric material, broken face and rubbed; about 20 percent fiber, less than 10 percent rubbed; weak medium subangular blocky structure; friable; many roots; neutral; clear wavy boundary.

Oa3—23 to 38 inches; black (5YR 2/1) sapric material, broken face and rubbed; about 15 percent fiber, less than 5 percent rubbed; massive; friable; few roots; neutral; clear wavy boundary.

Oa4—38 to 60 inches; dark reddish brown (5YR 2/2) sapric material, broken face and rubbed; about 20 percent fiber, less than 5 percent rubbed; massive; few roots; slightly acid.

The organic layer is more than 51 inches thick and is mainly herbaceous material.

Layers in the control section have hue of 10YR, 7.5YR, or 5YR, value of 2 or 3, and chroma of 1 to 3 or have hue of N and value of 2 or 3. The subsurface tier is slightly acid or neutral. The hemic material has a combined thickness of less than 10 inches, and the fibric material has a combined thickness of less than 5 inches.

Martinsville series

The Martinsville series consists of deep, well drained, moderately permeable soils on outwash plains and knolls on uplands. These soils formed in stratified glacial outwash materials. Slope ranges from 1 to 6 percent.

Martinsville soils are similar to Hillsdale and Metea soils and are commonly near Rensselaer and Whitaker soils. Hillsdale soils are underlain with sandy loam or loamy sand till and have less clay in the B horizon than Martinsville soils. Metea soils have more sand in the upper part of the B horizon and are underlain with glacial till. Rensselaer soils have a dark colored A horizon and are in depressional areas. Whitaker soils are mottled with gray or brighter colors and are in flatter areas.

Typical pedon of Martinsville sandy loam, 1 to 6 percent slopes, in a cultivated field, 1,200 feet south and 1,700 feet east of the northwest corner of sec. 22, T. 36 N., R. 10 E.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) sandy loam, light brownish gray (10YR 6/2) dry; weak fine subangular blocky structure; friable; many roots; neutral; abrupt smooth boundary.

B1t—9 to 18 inches; dark yellowish brown (10YR 4/4) loam; moderate fine subangular blocky structure; friable; many roots; discontinuous dark brown (7.5YR 4/4) clay films on faces of peds; slightly acid; clear smooth boundary.

B21t—18 to 31 inches; dark yellowish brown (10YR 4/4) sandy clay loam; moderate medium subangular blocky structure; friable; common roots; thin continuous dark brown (7.5YR 4/4) clay films on faces of peds; medium acid; gradual wavy boundary.

B22t—31 to 50 inches; dark yellowish brown (10YR 4/4) loam; moderate fine subangular blocky structure; friable; few roots; thin discontinuous dark brown (7.5YR 4/4) clay films on faces of peds; strongly acid; clear smooth boundary.

B3—50 to 58 inches; dark yellowish brown (10YR 4/4) loam; weak medium subangular blocky structure; friable; neutral; clear smooth boundary.

C—58 to 74 inches; yellowish brown (10YR 5/4) stratified loam, fine sandy loam, fine sand, and silt; massive; friable; strong effervescence; moderately alkaline.

The solum ranges from 36 to 60 inches in thickness.

The Ap horizon is dark grayish brown (10YR 4/2), brown (10YR 5/3), or yellowish brown (10YR 5/4). An A2 horizon or B1 horizon is in some pedons. The B2 horizon has hue of 10YR, 7.5YR, and less commonly 5YR, value of 4 to 6, and chroma of 3 to 6. It is clay loam, loam, sandy clay loam, silty clay loam, or sandy loam. The most acid part of the B2 horizon is strongly acid to slightly acid. The B3 horizon is similar in color to the B2 horizon. It is medium acid to mildly alkaline. The C horizon is brown (10YR 5/3) or yellowish brown (10YR 5/4) stratified sand, silt loam, sandy clay loam, loam, and silt.

Martisco series

The Martisco series consists of very poorly drained organic soils in depressional areas, commonly near lakes. These soils formed in mixed organic material less than 16 inches thick overlying highly calcareous marl. Permeability is moderately slow to moderately rapid in the organic material and slow in the marl. Slope ranges from 0 to 2 percent.

Martisco soils are similar to Adrian, Edwards, Houghton, and Palms soils. Adrian soils are underlain with sandy material. Edwards soils are underlain with marl at a depth of more than 16 inches. Houghton soils have more than 50 inches of muck. Palms soils are underlain with loamy material.

Typical pedon of Martisco muck, in pastureland, 650 feet west and 200 feet north of the southeast corner of sec. 10, T. 36 N., R. 10 E.

Oa1—0 to 7 inches; black (N 2/0) sapric material, broken face and rubbed; moderate medium granular structure; friable; many roots; neutral; abrupt smooth boundary.

Oa2—7 to 10 inches; black (N 2/0) sapric material, broken face and rubbed; weak coarse subangular blocky structure; friable; many roots; neutral; clear smooth boundary.

Lca1—10 to 13 inches; light brownish gray (10YR 6/2) marl; massive; friable; common white shell fragments; many roots; violent effervescence; moderately alkaline; gradual wavy boundary.

Lca2—13 to 60 inches; light gray (10YR 7/2) marl; massive; friable; common white shell fragments; violent effervescence; moderately alkaline.

The organic tier ranges from 8 to 16 inches in thickness.

The Oa horizon or Ap horizon is black (N 2/0 and 5YR 2/1). It is slightly acid to moderately alkaline. The C horizon ranges from gray (N 5/0 or 5Y 5/1) to white (10YR 8/2).

Metea series

The Metea series consists of deep, well drained, soils on moraines and till plains. These soils formed in glacial drift and the underlying glacial till. Permeability is very rapid in the sandy upper layers and moderate in the lower part of the solum. Slope ranges from 2 to 12 percent.

Metea soils are similar to Chelsea and Hillsdale soils and are commonly adjacent to Conover soils. Chelsea soils are sandier in the lower part of the profile than Metea soils. Hillsdale soils are sandier in the lower part of the B horizon and have a sandy loam or loamy sand C horizon. Conover soils are on lower lying positions, have mottling beginning above a depth of 20 inches, and are somewhat poorly drained.

Typical pedon of Metea loamy sand, 2 to 6 percent slopes, in a hay field, 100 feet south and 1,320 feet east of the center of sec. 21, T. 37 N., R. 9 E.

Ap—0 to 9 inches; dark brown (10YR 3/3) loamy sand, light brownish gray (10YR 6/2) dry; weak very fine granular structure; very friable; many roots; 1 percent coarse fragments; neutral; abrupt smooth boundary.

B21—9 to 18 inches; yellowish brown (10YR 5/4) loamy sand; weak fine subangular blocky structure; very friable; many roots; neutral; gradual wavy boundary.

B22—18 to 25 inches; dark yellowish brown (10YR 4/4) loamy sand; weak fine granular structure; very friable; common roots; 5 percent gravel; neutral; clear wavy boundary.

IIB23t—25 to 35 inches; dark yellowish brown (10YR 4/4) sandy loam; weak fine subangular blocky structure; friable; few roots; thin discontinuous (7.5YR 4/4) clay films on faces of peds; 5 percent gravel; medium acid; clear wavy boundary.

IIB24t—35 to 55 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium subangular blocky structure; firm; thin discontinuous (7.5YR 4/4) clay films on faces of peds; 2 percent gravel; medium acid; gradual wavy boundary.

IIB3—55 to 58 inches; dark yellowish brown (10YR 4/4) sandy loam; few fine distinct yellowish brown (10YR 5/8) mottles; weak fine subangular blocky structure; friable; slightly acid; 2 percent gravel; gradual wavy boundary.

IIC—58 to 72 inches; yellowish brown (10YR 5/4) loam; common medium faint (10YR 5/2) mottles; massive; friable; 2 percent gravel; strong effervescence; moderately alkaline.

The solum ranges from 36 to 60 inches in thickness.

The Ap horizon has hue of 10YR, value of 3 to 5, and chroma of 2 to 4. It is neutral to medium acid. The B21 and B22 horizons have hue of 10YR or 7.5YR, value of 4 to 6, chroma of 3 to 6. These horizons are loamy sand, loamy fine sand, or sand and are neutral to strongly acid. The IIB2 horizon has hue of 10YR, value of 4 or 5, and chroma of 3 to 8. It is dominantly clay loam or sandy clay loam, but subhorizons range to loam and sandy loam. This horizon is commonly slightly acid or medium acid, except in the lower part of some pedons where it ranges from neutral to moderately alkaline. The IIC horizon is commonly brown (10YR 5/3) or yellowish brown (10YR 5/4 to 5/8) loam, clay loam, or silty clay loam till.

Morley series

The Morley series consists of deep, moderately well drained, slowly permeable soils on undulating upland till plains and moraines. These soils formed in glacial till. Slope ranges from 2 to 14 percent.

Morley soils are similar to Wawasee and Rawson soils and are commonly adjacent to Blount, Haskins, and Pewamo soils. Wawasee soils contain less clay throughout the solum than Morley soils. Rawson soils contain more sand in the A horizon and in the upper part of the B horizon. Blount and Haskins soils are somewhat poorly drained, are mottled throughout the B horizon, and are in lower lying positions in the landscape. Pewamo soils are very poorly drained, have a darker colored A horizon and grayer profile and are in depressional areas.

Typical pedon of Morley loam, 2 to 6 percent slopes, eroded, in a cultivated field, 1,980 feet east and 75 feet south of the center of sec. 21, T. 37 N., R. 8 E.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) loam; light gray (10YR 7/2) dry; moderate medium granular structure; friable; many roots; 2 percent fine gravel; slightly acid; abrupt smooth boundary.

B21t—7 to 11 inches; yellowish brown (10YR 5/4) silty clay loam; strong medium angular and subangular blocky structure; firm; many roots; very thin discontinuous light brownish gray (10YR 6/2) silt coatings; thin discontinuous dark brown (10YR 4/3) clay films on most faces of peds; 3 percent fine gravel; medium acid; clear wavy boundary.

B22t—11 to 26 inches; brown (10YR 5/3) clay; strong medium and coarse angular blocky structure; very firm; few roots; few fine distinct yellowish brown (10YR 5/6) mottles; many dark brown (10YR 4/3) clay films on all faces of peds; 2 percent fine gravel; medium acid; gradual wavy boundary.

C—26 to 60 inches; brown (10YR 5/3) clay loam; massive; very firm; 2 percent gravel; strong effervescence; moderately alkaline.

The solum ranges from 20 to 36 inches in thickness.

The Ap horizon is dark grayish brown (10YR 4/2) or brown (10YR 4/3). The B2t horizon is silty clay loam, clay loam, silty clay, or clay containing 35 to 50 percent clay. The B horizon is strongly acid to neutral, except in the lower part. Near the contact with the C horizon, it is mildly alkaline or moderately alkaline in some profiles. The C horizon is silty clay loam to clay loam.

Nappanee series

The Nappanee series consists of deep, somewhat poorly drained soils on till plains. These soils formed in glacial till. Permeability is very slow. Slope ranges from 0 to 3 percent.

Nappanee soils are similar to Blount and Haskins soils and are adjacent to Pewamo soils. Blount and Haskins soils have less clay in the solum than Nappanee soils. Pewamo soils are in lower lying areas, have a darker colored A horizon, and are very poorly drained.

Typical pedon of Nappanee silt loam, 0 to 3 percent slopes, in a cultivated field, 500 feet south and 50 feet west of the northeast corner of sec. 31, T. 36 N., R. 8 E.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam, light gray (10YR 7/1) dry; moderate fine and medium granular structure; friable; many roots; neutral; abrupt smooth boundary.

A2—8 to 11 inches; light brownish gray (10YR 6/2) silt loam; moderate fine and medium granular structure; friable; many roots; neutral; clear smooth boundary.

IIB21t—11 to 19 inches; brown (10YR 5/3) clay; many medium distinct grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; common roots; discontinuous grayish brown (10YR 5/2) clay films; 2 percent gravel; slightly acid; clear smooth boundary.

IIB22t—19 to 28 inches; grayish brown (10YR 5/2) clay; many medium distinct yellowish brown (10YR 5/4) mottles; moderate medium and coarse angular blocky structure; very firm; few roots; discontinuous grayish brown (10YR 5/2) clay films; 2 percent gravel; slightly acid; clear smooth boundary.

IIB23t—28 to 32 inches; grayish brown (10YR 5/2) clay; many medium distinct yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure breaking to moderate coarse angular blocky; very firm; discontinuous light brownish gray (10YR 6/2) clay films; 2 percent gravel; slightly acid; gradual smooth boundary.

IIC—32 to 60 inches; light brownish gray (10YR 6/2) clay; few medium distinct yellowish brown (10YR 5/6) mottles; massive; firm; strong effervescence; moderately alkaline.

The solum is 20 to 36 inches thick.

The Ap horizon is dark grayish brown (10YR 4/2) or brown (10YR 4/3). The A2 horizon has granular or thin platy structure. The IIB21t horizon is brown (10YR 5/3) or light brownish gray (10YR 6/2). It has moderate, medium, subangular or angular blocky structure. The IIB22t horizon is grayish brown (10YR 5/2) or brown (10YR 5/3). The IIB23t horizon is grayish brown (10YR 5/2) or pale brown (10YR 6/3). The C horizon is grayish brown (10YR 5/2) or light brownish gray (10YR 6/2).

Oshtemo series

The Oshtemo series consists of deep, well drained soils on outwash plains and valley trains and on the stronger slopes of moraines and kames. These soils formed in loamy outwash. Permeability is moderately rapid in the subsoil and very rapid in the underlying material. Slope ranges from 0 to 25 percent.

Oshtemo soils are similar to Boyer and Hillsdale soils and commonly adjacent to Brady and Gilford soils. Boyer soils are moderately deep over sand and gravel. Hillsdale soils are underlain with loamy sand or sandy loam till. Brady soils are on lower lying positions than Oshtemo soils, have mottling above a depth of 20 inches, and are somewhat poorly drained. Gilford soils are in depressional areas, have a darker colored solum, and are very poorly drained.

Typical pedon of Oshtemo loamy sand, 0 to 2 percent slopes, in a cultivated field, 1,700 feet east and 400 feet south of the northwest corner of sec. 32, T. 37 N., R. 8 E.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) loamy sand; light brownish gray (10YR 6/2) dry; weak fine granular structure; friable; many roots; 3 percent fine gravel; slightly acid; abrupt smooth boundary.

B1—9 to 16 inches; dark yellowish brown (10YR 3/4) sandy loam; weak fine subangular blocky structure; friable; many roots; 3 percent fine gravel; slightly acid; clear smooth boundary.

B21t—16 to 30 inches; brown (10YR 4/3) sandy loam; weak medium subangular blocky structure; friable; common roots; thin patchy dark brown (7.5YR 4/4) clay films on faces of peds and bridging sand grains; 5 percent gravel; slightly acid; clear smooth boundary.

B22t—30 to 36 inches; brown (7.5YR 4/4) gravelly sandy clay loam; moderate medium subangular blocky structure; firm; few roots; thin discontinuous dark brown (7.5YR 3/2) clay films on faces of peds; slightly acid; clear wavy boundary.

B23t—36 to 42 inches; brown (7.5YR 4/4) sandy loam; weak medium subangular blocky structure; friable; thin patchy dark brown (7.5YR 3/2) clay films on faces of peds and bridging sand grains; 5 percent gravel; slightly acid; clear wavy boundary.

B3—42 to 53 inches; dark reddish brown (5YR 3/3) sandy loam; weak medium subangular blocky structure; friable; 10 percent fine gravel; neutral; abrupt irregular boundary.

IIC—53 to 60 inches; brown (10YR 5/3) very gravelly coarse sand; single grain; loose; strong effervescence; moderately alkaline.

The solum is 42 to 66 inches thick.

The Ap horizon is very dark grayish brown (10YR 3/2), dark grayish brown (10YR 4/2), or brown (10YR 4/3)

loamy sand or sandy loam. The B1 horizon, where present, is loamy sand or sandy loam. The Bt horizon has hue of 5YR, 7.5YR or 10YR, value of 3 to 5, and chroma of 3 to 6. It is dominantly sandy loam or gravelly sandy loam, but in some pedons contains subhorizons as much as 6 inches thick of gravelly sandy clay loam or sandy clay loam. The reaction ranges from slightly acid to strongly acid. The B3 horizon is loamy sand or has thin strata 1/4 inch to 2 inches of loamy sand or sandy loam separated by sand. The IIC horizon is dominantly stratified coarse sand and very gravelly sand, mainly derived from granite and limestone. In some pedons, the IIC horizon contains some stones and boulders.

Palms series

The Palms series consists of deep, very poorly drained soils in depressional areas on outwash plains, till plains, and moraines. These soils formed in decomposed organic material over mineral material. Permeability is moderately slow to moderately rapid in the organic layers and moderate in the mineral material. Slope ranges from 0 to 2 percent.

Palms soils are similar to Adrian, Edwards, Houghton, and Martisco soils. Adrian soils are underlain with sandy material. Houghton soils have a much thicker organic layer than Palms soils. Edwards and Martisco soils are underlain with marl.

Typical pedon of Palms muck, drained, in pasture, 1,825 feet south and 1,025 feet west of the northeast corner of sec. 23, T. 36 N., R. 9 E.

Oa1—0 to 11 inches; black (10YR 2/1) sapric material, broken face and rubbed; about 5 percent fiber, less than 5 percent rubbed; weak fine granular structure; many roots; herbaceous fibers; slightly acid; abrupt smooth boundary.

Oa2—11 to 22 inches; black (10YR 2/1) sapric material, broken face and rubbed; about 5 percent fiber, less than 5 percent rubbed; weak medium subangular blocky structure; many roots; herbaceous fibers; neutral; clear smooth boundary.

Oa3—22 to 26 inches; very dark gray (10YR 3/1) sapric material, broken face and rubbed; about 5 percent fiber, less than 5 percent rubbed; weak medium subangular blocky structure; common roots; herbaceous fibers; small amount of dark grayish brown (10YR 4/2) mineral material in lower part of horizon; neutral; clear smooth boundary.

IICg—26 to 60 inches; grayish brown (10YR 5/2) silt loam; massive; friable; strong effervescence; moderately alkaline.

The loamy IIC horizon is at a depth of 20 to 50 inches. The fiber is derived mainly from herbaceous plants. The organic part of the control section below the surface tier ranges from medium acid to mildly alkaline.

The organic part of the subsurface and bottom tiers has hue of 10YR, 7.5YR, or 5YR, value of 2 or 3, and chroma of 1 to 3 or has hue of N and value of 2 or 3. The IIC horizon has hue of 10YR or 2.5Y, value of 4, 5, or 6, and chroma of 1 or 2. It is fine sandy loam to clay loam and has an average of less than 35 percent clay. It is slightly acid to moderately alkaline.

Parr series

The Parr series consists of deep, well drained, moderately permeable soils on till plains. These soils formed in glacial till. Slope ranges from 0 to 2 percent.

Parr soils are similar to Wawasee and Shipshe soils. Wawasee soils have a lighter colored A horizon than Parr soils. Shipshe soils have more sand in the B horizon and in the upper part of the C horizon.

A typical pedon of Parr loam, 0 to 2 percent slopes, in a cultivated field, 1,600 feet east and 200 feet north of the southwest corner of sec. 36, T. 36 N., R. 8 E.

Ap—0 to 9 inches; very dark brown (10YR 2/2) loam, grayish brown (10YR 5/2) dry; weak medium granular structure; friable; many fine roots; slightly acid; abrupt smooth boundary.

A12—9 to 14 inches; very dark grayish brown (10YR 3/2) loam; weak fine subangular blocky structure; friable; common fine roots; slightly acid; clear wavy boundary.

B1—14 to 19 inches; dark yellowish brown (10YR 4/4) loam; weak medium granular structure; friable; few fine roots; 5 percent gravel; slightly acid; gradual wavy boundary.

B21t—19 to 23 inches; yellowish brown (10YR 5/4) clay loam; moderate fine subangular blocky structure; friable; thin discontinuous very dark brown (10YR 2/2) clay films and organic coatings as linings on some voids and on some ped faces; 5 percent gravel; medium acid; clear smooth boundary.

B22t—23 to 33 inches; yellowish brown (10YR 5/4) clay loam; moderate medium subangular blocky structure; firm; thin discontinuous very dark brown (10YR 2/2) clay films and organic coatings as linings on some voids and on some ped faces; 5 percent gravel; medium acid; clear smooth boundary.

C—33 to 60 inches; light yellowish brown (10YR 6/4) loam; massive; friable; 10 percent gravel; strong effervescence; moderately alkaline.

The solum ranges from 24 to 42 inches in thickness.

The A horizon is very dark grayish brown (10YR 3/2), very dark gray (10YR 3/1), or very dark brown (10YR 2/2). The B horizon is yellowish brown (10YR 5/4), dark yellowish brown (10YR 4/4 and 4/3), or dark brown (7.5YR 4/4) clay loam or loam. It is medium acid or slightly acid. The C horizon is very pale brown (10YR 7/4), pale brown (10YR 6/3), light yellowish brown (10YR 6/4), or yellowish brown (10YR 5/4).

Pewamo series

The Pewamo series consists of deep, very poorly drained soils on till plains. These soils formed in glacial till. Permeability is moderately slow. Slope ranges from 0 to 2 percent.

Pewamo soils are similar to Rensselaer and Sebewa soils and are near Blount, Morley, and Nappanee soils. Rensselaer soils have less clay and more silt throughout the profile than Pewamo soils. Sebewa soils have less clay throughout the profile and are underlain with sand and gravelly sand. Blount soils are somewhat poorly drained, have a light colored A horizon surface, and are on slightly higher lying positions. Morley soils are moderately well drained or well drained, are on higher lying positions, and have brighter colors throughout the solum. Nappanee soils are somewhat poorly drained, have a light colored A horizon, have a higher percentage of clay throughout the solum, and are on slightly higher lying positions.

Typical pedon of Pewamo silty clay loam, in a pasture, 1,000 feet west and 100 feet north of the southeast corner of sec. 15, T. 36 N., R. 8 E.

Ap—0 to 7 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; weak medium granular structure; firm; many fine roots; 1 percent fine gravel; neutral; abrupt smooth boundary.

A12—7 to 12 inches; very dark gray (10YR 3/1) silty clay loam; few fine faint yellowish brown (10YR 5/8) mottles; many fine roots; 1 percent fine gravel; weak fine subangular blocky structure; firm; neutral; gradual wavy boundary.

B21tg—12 to 20 inches; dark gray (10YR 4/1) silty clay; common fine distinct yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure parting to moderate medium subangular blocky; firm; few fine roots; continuous very dark gray (10YR 3/1) clay films on faces of peds; 1 percent gravel; neutral; gradual wavy boundary.

B22tg—20 to 32 inches; gray (10YR 5/1) silty clay; common medium distinct brown (7.5YR 4/4) and strong brown (7.5YR 5/6) mottles; weak coarse prismatic structure parting to strong medium angular blocky; firm; few fine roots; continuous dark gray (10YR 4/4) clay films on faces of peds; 1 percent gravel; neutral; gradual wavy boundary.

B23tg—32 to 44 inches; gray (10YR 5/1) clay; common medium distinct brown (7.5YR 4/4) and strong brown (7.5YR 5/6) mottles; weak coarse prismatic structure parting to strong medium angular blocky; firm; thin patchy dark gray (10YR 4/1) clay films on faces of peds; 1 percent gravel; neutral; clear smooth boundary.

C—44 to 60 inches; gray (10YR 6/1) clay loam; many medium prominent yellowish brown (10YR 5/6) mottles; massive; firm; 2 percent fine gravel; strong effervescence; moderately alkaline.

The solum ranges from 28 to 50 inches in thickness.

The A horizon is black (10YR 2/1), very dark gray (10YR 3/1), or very dark grayish brown (10YR 3/2). It is neutral or slightly acid. The B horizon has hue of 2.5YR, 5Y, or 10YR, value of 4 or 6, and chroma of 1 or 2. The upper 20 inches of the B2 horizon typically has an average of 40 to 50 percent clay, but the B2 horizon in some pedons has an average of 35 percent clay. The B21t and B22t horizons are slightly acid or neutral. The B23t horizon or the horizon immediately above the C horizon is neutral or mildly alkaline. The C horizon has hue of 10YR to 5Y, value of 4 or 6, and chroma of 1 or 2. It is clay loam or silty clay loam.

Plainfield series

The Plainfield series consists of deep, excessively drained, rapidly permeable soils on outwash plains, knolls, and eolian dunes. These soils formed in wind- or water-deposited sand. Slope ranges from 0 to 12 percent.

Plainfield soils are similar to Chelsea soils and are commonly adjacent to Brems soils. Chelsea soils have a thin, banded B horizon above a depth of 60 inches. Brems soils are moderately well drained, have mottles in the lower part of the B horizon, and are on slightly lower positions in the landscape than Plainfield soils.

Typical pedon of Plainfield sand, 2 to 6 percent slopes, in a cultivated field, 1,000 feet east and 100 feet north of the center of sec. 10, T. 37 N., R. 11 E.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) sand, light brownish gray (10YR 6/2) dry; weak medium granular structure; very friable; few fine roots; strongly acid; abrupt smooth boundary.

B21—9 to 19 inches; strong brown (7.5YR 5/6) sand; single grain; loose; strongly acid; clear wavy boundary.

B22—19 to 24 inches; strong brown (7.5YR 5/6) sand; single grain; loose; medium acid; clear wavy boundary.

B23—24 to 32 inches; yellowish brown (10YR 5/6) sand; single grain; loose; medium acid; gradual wavy boundary.

C1—32 to 40 inches; brownish yellow (10YR 6/6) sand; single grain; loose; 15 percent dark minerals; medium acid; gradual wavy boundary.

C2—40 to 60 inches; light yellowish brown (10YR 6/4) sand; single grain; loose; medium acid.

The solum is 18 to 34 inches thick. Reaction throughout the solum is medium acid or strongly acid.

The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3. The B horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 3 to 6. The C horizon has hue of 10YR or 7.5YR, value of 5 to 7, and chroma of 4 to 8.

Rawson series

The Rawson series consists of deep, moderately well drained and well drained soils on moraines. These soils formed in glacial drift and the underlying glacial till. Permeability is moderate in the upper part of the solum and slow or very slow in the lower part of the solum and underlying material. Slope ranges from 2 to 6 percent.

The Rawson soils in Lagrange County have less clay content in the IIB and C horizons than is defined in the range for the series, but this difference does not alter the use or behavior of the soil.

Rawson soils are similar to Wawasee and Morley soils and adjacent to Blount and Haskins soils. Wawasee soils contain less clay in the lower part of the B horizon and in the C horizon than Rawson soils. Morley soils contain more clay in the upper part of the B horizon. Blount soils contain more clay in the upper part of the B horizon. Blount and Haskins soils have grayer colors throughout the solum, and are somewhat poorly drained.

Typical pedon of Rawson sandy loam, 2 to 6 percent slopes, in a hay field, 2,500 feet north and 1,500 feet east of the southwest corner of sec. 8, T. 37 N., R. 8 E.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) sandy loam, light brownish gray (10YR 6/2) dry; weak fine and medium granular structure; friable; many medium roots; 2 percent gravel; slightly acid; abrupt smooth boundary.

A2—9 to 13 inches; yellowish brown (10YR 5/4) loam; weak fine subangular blocky structure; friable; many medium roots; few dark grayish brown (10YR 4/2) organic stains in root channels; 2 percent gravel; slightly acid; clear smooth boundary.

Bt—13 to 18 inches; brown (10YR 4/3) loam; weak fine subangular blocky structure; friable; thin discontinuous dark brown (7.5YR 4/4) clay films on faces of peds; common medium roots; 2 percent gravel; medium acid; clear wavy boundary.

B21t—18 to 25 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium subangular blocky structure; firm; few medium roots; thin continuous dark brown (7.5YR 4/4) clay films on faces of peds; 2 percent gravel; medium acid; gradual wavy boundary.

IIB22t—25 to 35 inches; brown (7.5YR 4/4) clay loam; strong medium and coarse subangular blocky structure; very firm; thin continuous dark brown (7.5YR 4/2) clay films on faces of peds; medium acid; clear smooth boundary.

IIB3t—35 to 39 inches; yellowish brown (10YR 5/4) clay loam; few fine faint grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; discontinuous dark brown (7.5YR 4/2) clay films on faces of peds; neutral; gradual wavy boundary.

IIC—39 to 60 inches; yellowish brown (10YR 5/4) clay loam; few fine faint yellowish brown (10YR 5/6) mottles; massive; firm; strong effervescence; moderately alkaline.

The solum ranges from 24 to 48 inches in thickness.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. This horizon is sandy loam or loam and is neutral to strongly acid. The B horizon has hue of 10YR and 7.5YR, value of 4 or 5, and chroma of 3 to 6. It is clay loam, sandy clay loam, or loam, or gravelly phases of these textures. The B horizon is slightly acid to strongly acid. The IIB horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. The IIB horizon is clay loam, or silty clay loam. It is slightly acid to mildly alkaline. The IIC horizon is clay loam or silty clay loam.

Rensselaer series

The Rensselaer series consists of deep, very poorly drained, slowly permeable soils on terraces, lake plains, and outwash plains. These soils formed in sediment that settled out of water in glacial drainageways. Slope ranges from 0 to 2 percent.

Rensselaer soils are similar to Sebewa soils and adjacent to Whitaker soils. Sebewa soils contain more sand throughout the solum than Rensselaer soils and are underlain with sand and gravelly sand. Whitaker soils are on slightly higher positions, have brighter colors, and are somewhat poorly drained.

Typical pedon of Rensselaer loam in a cultivated field, 50 feet north and 50 feet east of the southwest corner of sec. 15, T. 36 N., R. 10 E.

Ap—0 to 7 inches; very dark gray (10YR 3/1) loam, grayish brown (10YR 5/2) dry; weak fine and medium granular structure; friable; common roots; neutral; clear smooth boundary.

A12—7 to 11 inches; very dark gray (10YR 3/1) silty clay loam; moderate very fine subangular blocky structure; friable; common roots; neutral; gradual smooth boundary.

B1g—11 to 15 inches; dark gray (10YR 4/1) clay loam; common fine distinct gray (10YR 5/1) and yellowish brown (10YR 5/6) mottles; moderate fine subangular blocky structure; firm; few roots; neutral; gradual smooth boundary.

B21tg—15 to 24 inches; gray (10YR 5/1) clay loam; common fine distinct yellowish brown (10YR 5/6) and brownish yellow (10YR 6/6) mottles; moderate medium subangular blocky and angular blocky structure; few roots; thin continuous dark gray (10YR 4/1) clay films on faces of peds; 2 percent gravel; neutral; gradual wavy boundary.

B22tg—24 to 35 inches; gray (10YR 5/1) clay loam; many medium distinct yellowish brown (10YR 5/6) and brownish yellow (10YR 6/6) and few fine distinct strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; firm; thin con-

tinuous dark gray (10YR 4/1) clay films on faces of peds; 2 percent gravel; neutral; gradual wavy boundary.

B3g—35 to 44 inches; gray (10YR 5/1) stratified fine sandy loam and silty clay loam; many medium distinct yellowish brown (10YR 5/6) and brownish yellow (10YR 6/6) and few fine distinct strong brown (7.5YR 5/6) mottles; massive; friable; mildly alkaline; clear wavy boundary.

Cg—44 to 60 inches; gray (10YR 5/1) stratified fine sand, silt, clay loam, and silty clay loam; many medium distinct yellowish brown (10YR 5/6) mottles; massive; friable; strong effervescence; moderately alkaline.

The solum is 34 to 42 inches thick and generally corresponds to depth to calcareous material, but in some pedons the carbonates are at a slightly greater depth.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2 or is black (N 2/0). The A horizon is loam, silt loam, or silty clay loam. The B2t horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 or 2. This horizon has mottles that have chroma of more than 2. It is clay loam, sandy clay loam, or silty clay loam and is slightly acid or neutral. The C horizon is stratified and contains layers of silty clay loam, clay loam, silt, fine sand, and loam.

Sebewa series

The Sebewa series consists of very poorly drained soils on glacial outwash plains and valley trains. These soils formed in glacial outwash. They are moderately deep over sand and gravel. Permeability is moderate in the solum and rapid in the underlying material. Slope ranges from 0 to 2 percent.

Sebewa soils are similar to Gilford and Rensselaer soils and are adjacent to Homer soils. Gilford soils contain less clay in the B horizon than Sebewa soils. Rensselaer soils contain more silt, and the C horizon has more silt and clay. Homer soils have brighter colors throughout the solum, are somewhat poorly drained, and are on slightly higher positions.

Typical pedon of Sebewa loam, in a cultivated field, 1,340 feet east of the northwest corner of sec. 16, T. 36 N., R. 8 E.

Ap—0 to 11 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; friable; common medium roots; 2 percent fine gravel; neutral; abrupt smooth boundary.

B21tg—11 to 15 inches; dark gray (10YR 4/1) clay loam; many medium distinct dark brown (10YR 4/3) mottles; strong medium angular blocky structure; firm; common medium roots; thin discontinuous brown (10YR 5/2) clay films on some ped faces and as linings in channels; 5 percent fine gravel; neutral; gradual wavy boundary.

B22tg—15 to 27 inches; dark grayish brown (10YR 4/2) clay loam; many coarse distinct yellowish brown (10YR 5/8) mottles; strong medium subangular blocky structure; firm; common fine roots; continuous dark gray (10YR 4/1) clay films on some ped faces and as void linings; very dark gray (10YR 3/1) organic coatings in root channels; 10 percent fine gravel; neutral; gradual wavy boundary.

B23tg—27 to 33 inches; grayish brown (10YR 5/2) sandy clay loam; common fine distinct yellowish brown (10YR 5/8) mottles; moderate medium subangular blocky structure; friable; discontinuous dark gray (10YR 4/1) clay films on some peds and as void linings; 10 percent gravel; neutral; clear irregular boundary.

IIC—33 to 60 inches; dark grayish brown (10YR 5/2) stratified coarse sand and gravelly sand; single grain; loose; 25 percent gravel; strong effervescence; moderately alkaline.

The solum is 24 to 40 inches thick.

The Ap horizon is black (10YR 2/1), very dark gray (10YR 3/1), or very dark brown (10YR 2/2). It is 10 to 15 inches thick. The B2t horizon is clay loam, sandy clay loam, gravelly clay loam, or gravelly sandy clay loam. The IIC horizon is light brownish gray (10YR 6/2) or grayish brown (10YR 5/2).

Shipshe series

The Shipshe series consists of well drained soils on outwash plains. These soils formed in sandy outwash overlying sand and gravel. They are moderately deep over the sand and gravel. Permeability is moderately rapid in the solum and very rapid in the underlying material. Slope ranges from 0 to 12 percent.

Shipshe soils are similar to the Boyer and Parr soils. Boyer soils do not have a mollic epipedon. Parr soils contain less gravel than Shipshe soils, are finer textured, and are underlain with a layer of loam till over sand and gravel.

Typical pedon of Shipshe sandy loam, 2 to 6 percent slopes, in a cultivated field, 2,000 feet north and 100 feet west of the southeast corner of sec. 31, T. 38 N., R. 11 E.

Ap—0 to 8 inches; black (10YR 2/1) sandy loam, dark gray (10YR 4/1) dry; moderate fine granular structure; friable; many medium roots; few fine pebbles; slightly acid; abrupt smooth boundary.

A12—8 to 12 inches; very dark brown (10YR 2/2) sandy loam, dark gray (10YR 4/1) dry; moderate fine granular structure; friable; many fine roots; common fine pebbles; medium acid; gradual wavy boundary.

B21t—12 to 15 inches; dark brown (7.5YR 3/2) very gravelly sandy loam; moderate medium subangular blocky structure; firm; common fine roots; thin dark brown (10YR 3/3) clay films on sand grains and as

linings of some voids; 54 percent gravel; medium acid; clear wavy boundary.

B22t—15 to 24 inches; dark reddish brown (5YR 3/3) very gravelly sandy loam; moderate medium subangular blocky structure; friable; few fine roots; thin dark brown (10YR 3/3) clay films on some sand grains and as lining of voids; 62 percent gravel; medium acid; clear wavy boundary.

B3—24 to 32 inches; dark reddish brown (5YR 3/3) very gravelly sandy loam; weak fine granular structure; friable; 46 percent gravel; medium acid; diffuse irregular boundary.

IIC—32 to 60 inches; yellowish brown (10YR 5/4) stratified gravelly sand and sand; single grain; loose; 45 percent gravel; strong effervescence; moderately alkaline.

The solum ranges from 24 to 40 inches in thickness.

The A horizon has hue of 10YR, value of 2, and chroma of 1 or 2. It is neutral to medium acid. The B2t horizon has hue of 10YR, 7.5YR, or 5YR, value of 3 or 4, chroma of 2 to 4. It is typically very gravelly sandy loam, but is loam, sandy clay loam, loamy sand, gravelly loam, gravelly sandy loam, or gravelly loamy sand in some pedons. The B2t horizon has an average gravel content of 35 to 60 percent, by volume. This horizon is slightly acid to medium acid.

Wallkill series

The Wallkill series consists of deep, very poorly drained soils in depressional areas on uplands and outwash plains. These soils formed in loamy alluvial material overlying organic material. Permeability is moderate in the mineral layer and moderately slow to moderately rapid in the organic layer. Slope ranges from 0 to 2 percent.

The Wallkill soils in Lagrange County have less sand in the B and C horizons than is defined in the range for the series. This difference, however, does not alter the use or behavior of the soil.

Wallkill soils are similar to Adrian, Edwards, Houghton, Martisco, and Palms soils and are commonly adjacent to Rensselaer soils. The similar soils all have an organic surface layer. Adrian soils are underlain with sandy material. Edwards and Martisco soils are underlain with marl. Houghton soils have at least 51 inches of organic material, and Palms soils are underlain with loamy material. Rensselaer are mineral soils that are generally in depressional positions, and they surround areas of Wallkill soils.

Typical pedon of Wallkill silt loam, in a cultivated field, 150 feet north and 150 feet east of the center of sec. 21, T. 37 N., R. 8 E.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; moderate medium granular structure; friable; common fine roots; neutral; clear wavy boundary.

Bg—9 to 17 inches; gray (10YR 5/1) silt loam; very dark gray (10YR 3/1) organic fillings in voids; common fine distinct yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure; firm; few fine roots; neutral; clear wavy boundary.

Cg—17 to 21 inches; gray (10YR 5/1) silt loam; very dark gray (10YR 3/1) organic fillings in voids; common fine distinct yellowish brown (10YR 5/6) mottles; massive; firm; neutral; gradual wavy boundary.

IIOa1—21 to 25 inches; black (10YR 2/1) rubbed sapric material; about 30 percent fiber, less than 10 percent rubbed; gray (10YR 5/1) silt loam in voids; massive; friable; dark reddish brown (5YR 3/2) herbaceous and woody fibers; neutral; gradual wavy boundary.

IIOa2—25 to 60 inches; black (10YR 2/1) rubbed sapric material; about 40 percent fiber; less than 10 percent rubbed; massive; friable; dark reddish brown (5YR 3/2) herbaceous and woody fibers; neutral.

The mineral soil over the organic material is 16 to 36 inches thick.

The Ap horizon is very dark grayish brown (10YR 3/2) dark brown (10YR 3/3), dark gray (10YR 4/1), or dark grayish brown (10YR 4/2). It is sandy loam, loam, and silt loam. The B and C horizons have hue of 10YR or 2.5Y, value of 3 to 5, and chroma of 1 or 2. They are silt loam or loam. The underlying IIO layer is hemic or sapric material, or both, and includes woody or herbaceous plant material or both. This layer is neutral to medium acid.

Wawasee series

The Wawasee series consists of deep, well drained, moderately permeable soils on till plains and moraines. These soils formed in glacial till. Slope ranges from 0 to 18 percent.

Wawasee soils are similar to Hillsdale, Martinsville, Metea, and Morley soils and are adjacent to Conover soils. Hillsdale and Martinsville soils have a solum that is more than 40 inches thick. Hillsdale soils are underlain with sandy loam or loamy sand till, and Martinsville soils are underlain with stratified material. Metea soils have more sand in the A horizon and the upper part of the B horizon than Wawasee soils. Morley soils have more clay in the solum. Conover soils are on slightly lower positions, have mottling above a depth of 20 inches, and are somewhat poorly drained.

Typical pedon of Wawasee fine sandy loam, 2 to 6 percent slopes, in a hay field, 200 feet south and 100 feet east of the northwest corner of sec. 35, T. 37 N., R. 10 E.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) fine sandy loam, light brownish gray (10YR 6/2) dry; weak fine granular structure; friable; many fine roots; slightly acid; abrupt smooth boundary.

A2—8 to 12 inches; yellowish brown (10YR 5/4) loam; weak fine subangular blocky structure; friable; many fine roots; 2 percent gravel; slightly acid; clear smooth boundary.

B21t—12 to 22 inches; dark yellowish brown (10YR 4/4) loam; moderate medium subangular blocky structure; firm; few fine roots; 2 percent gravel; thin patchy dark brown (10YR 3/3) clay films on faces of peds; medium acid; clear smooth boundary.

B22t—22 to 35 inches; dark yellowish brown (10YR 4/4) loam; moderate medium and coarse subangular blocky structure; firm; few fine roots; 2 percent gravel; thin discontinuous dark brown (10YR 3/3) clay films on faces of peds; slightly acid; clear wavy boundary.

B3—35 to 38 inches; dark yellowish brown (10YR 4/4) loam; moderate medium subangular blocky structure; firm; 2 percent gravel; neutral; clear irregular boundary.

C—38 to 60 inches; brown (10YR 5/3) loam; massive; friable; 2 percent gravel; strong effervescence; moderately alkaline.

The solum ranges from 20 to 40 inches in thickness. The A horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. It is fine sandy loam, sandy loam, or loam. The A2 horizon, where present, has hue of 10YR, value of 5 or 6, and chroma of 2 to 4. The B1 horizon, where present, has hue of 10YR, value of 3 to 5, and chroma of 3 or 4. The Bt horizon has hue of 10YR, value of 4 or 5, and chroma of 3 to 6. This horizon is loam or sandy clay loam, but has thin layers of clay loam. The B3 horizon has hue of 10YR, value of 4 to 6, and chroma of 3 or 4. It is loam or sandy loam. The C horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 2 to 6. The C horizon is loam or sandy loam.

Whitaker series

The Whitaker series consists of deep, somewhat poorly drained, moderately permeable soils on lake plains, uplands, or outwash plains. These soils formed in stratified loamy sediment that settled out of slow moving water. Slope ranges from 0 to 2 percent.

Whitaker soils are similar to Conover and Homer soils and are commonly adjacent to Martinsville and Rensselaer soils. Conover soils are underlain with loam till. Homer soils are underlain with sand and gravel. Martinsville soils are on higher lying positions than Whitaker soils, have brighter colors, and are well drained. Rensselaer soils are in depressional areas, have darker or grayer colors throughout the solum, and are very poorly drained.

Typical pedon of Whitaker sandy loam, in a cultivated field, 600 feet south and 200 feet east of the northwest corner of sec. 22, T. 36 N., R. 10 E.

Ap—0 to 10 inches; dark grayish brown (10YR 4/2) sandy loam, light brownish gray (10YR 6/2) dry; moderate fine and medium granular structure; friable; many fine and medium roots; common fine dark brown (10YR 3/3) iron and manganese oxide accumulations; neutral; abrupt smooth boundary.

A2—10 to 14 inches; brown (10YR 5/3) sandy loam; few medium faint grayish brown (10YR 5/2) and few medium distinct yellowish brown (10YR 5/6) mottles; weak thick platy structure; friable; common fine roots; common very dark grayish brown (10YR 3/2) root fills; few fine dark brown (10YR 3/3) iron and manganese oxide accumulations; slightly acid; clear wavy boundary.

B2t—14 to 32 inches; grayish brown (10YR 5/2) sandy clay loam; many medium distinct yellowish brown (10YR 5/6) and common medium faint light brownish gray (10YR 6/2) mottles; moderate medium subangular blocky structure; friable; few fine roots; continuous faint thin grayish brown (10YR 5/2) clay films on faces of peds; few medium dark brown (10YR 3/3) iron and manganese oxide accumulations; medium acid; clear wavy boundary.

B3—32 to 38 inches; yellowish brown (10YR 5/4) loam; many medium faint yellowish brown (10YR 5/6) and many medium distinct light brownish gray (10YR 6/2) mottles; weak coarse subangular blocky structure; friable; slightly acid; gradual wavy boundary.

C—38 to 60 inches; mottled light olive brown (2.5Y 5/6) and light brownish gray (10YR 6/2) stratified fine sand, silt, and silty clay loam; massive; friable; strong effervescence; moderately alkaline.

The solum ranges from 36 to 60 inches in thickness. The Ap horizon is dark grayish brown (10YR 4/2) or dark brown (10YR 4/3) loam or sandy loam. The B2 horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 to 4. This horizon is loam, sandy loam, clay loam, silty clay loam, or sandy clay loam. The C horizon is commonly stratified silt loam, fine sand, and silty clay loam. It contains thin layers of clay.

Formation of the soils

In this section, the major factors of soil formation are discussed, and the degree of importance of these factors to formation of the soils in the county are explained.

Factors of soil formation

Soil is produced by soil forming processes acting on materials deposited or accumulated by geologic agencies. The characteristics of the soil at any given point are determined by (1) the physical and mineralogical composition of the parent material, (2) the climate under which the soil material has accumulated and existed since accumulation, (3) the plant and animal life on and in the soil, (4) the relief, or lay of the land, and (5) the length of time the forces of soil formation have acted on the soil material.

Climate and plant and animal life, chiefly plants, are active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it to a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material also affects the kind of profile that forms and, in extreme cases, determines it almost entirely. Finally, time is needed for changing the parent material into a soil profile. Generally, a long time is required for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four. Many of the processes of soil development are unknown.

Parent material

Parent material is the unconsolidated mass from which a soil is formed. The parent materials of the soils in Lagrange County were deposited by glaciers or by melt water from the glaciers. Some of these materials were reworked and redeposited by subsequent actions of water and wind. These glaciers covered the county about 10,000 to 12,000 years ago. Parent material determines the limits of the chemical and mineralogical composition of the soil. Although parent materials are of glacial origin, their properties vary greatly, sometimes within small areas, depending on how the materials were deposited. The dominant parent materials in Lagrange County are glacial till, outwash deposits, lacustrine deposits, and organic material.

Glacial till is material laid down directly by glaciers with a minimum of water action. It consists of a mixture of particles of different sizes. Some of the small pebbles in glacial till have sharp corners, indicating that they have not been worn by water washing. The glacial till in Lagrange County is calcareous, friable or firm loamy sand, sandy loam, loam, clay loam, silty clay loam, or clay. An example of soils formed in glacial till are the Wawasee soils. Typically, these soils are moderately coarse or medium textured and have well developed structure.

Outwash materials were deposited by running water from melting glaciers. The size of the particles that make up outwash material varies according to the velocity of the running water. When fast moving water slows down, the coarser particles are deposited. Finer particles, such as very fine sand, silt, and clay, are carried by slower moving water. Outwash deposits generally consist of layers of particles of similar size, such as sandy loam, sand, and gravel. In Lagrange County, the Boyer soils are examples of soils that formed in outwash material.

Lacustrine materials were deposited by still, or ponded, glacial melt water. The coarser fragments dropped out of moving water as outwash, and only the finer particles such as very fine sand, silt, and clay remained in the still water. Lacustrine deposits are silty or clayey in texture. In Lagrange County, the soils that formed in lacustrine deposits are typically medium textured or moderately fine textured. The Rensselaer soils are examples of soils that formed in lacustrine materials.

The organic material is made up of deposits of plant remains. After the glaciers withdrew from the area, water was left standing in lakes and depressions. Grasses and sedges growing in the depressions and around the edges of the lakes died. Because of wetness of the areas, the plant remains did not decompose but remained around the edges or fell to the bottom. Later, white cedar and other water-tolerant trees grew in the areas. When these trees died, their residue became a part of the organic accumulation. Subsequently, the lakes and depressions filled with organic material. The plant remains decomposed and muck developed. The Houghton soils are examples of soils that formed in organic material.

Plant and animal life

Plants have been the principal organism influencing the soils in Lagrange County; however, bacteria, fungi, earthworms, and the activities of man have also been important. The chief contribution of plants and animals is the addition of organic matter and nitrogen to the soil. The kind of organic material on and in the soil depends on the kind of plants that grew on the soil. In places, the partially decomposed remains of plants accumulate on the surface as an organic layer. Roots of the plants provide channels for downward movement of water through the soil and also add organic matter as they decay. Bacteria in the soil help to break down the organic matter so that it can be used by growing plants.

The vegetation in Lagrange County was mainly deciduous forests. Differences in natural soil drainage and minor changes in parent material have affected the composition of the forest species.

In general, the well drained soils on uplands such as Wawasee and Hillsdale soils were mainly covered with sugar maple, yellow-poplar, white oak, red oak, and ash. The Plainfield soils were covered with jack pine and scrub oak. Plant cover on the wet soils in the county consisted mainly of swamp white oak, bur oak, maple, and cottonwood. A few wet soils also supported sphagnum and other mosses that contributed substantially to the accumulation of organic matter. The Sebewa and Rensselaer soils formed under wet conditions and contain considerable organic matter.

Climate

Climate is important in the formation of soils. It determines the kind of plants and animal life on and in the soil. It determines the amount of water available for weathering of minerals and transporting of soil materials. Climate, through its influence on temperatures in the soil, determines the rate of chemical reaction that occurs in the soil. These influences are important, but affect large

areas rather than a relatively small area, such as a county.

The climate in Lagrange County is cool and humid. It is presumed to be similar to that which existed when the soils formed. The soils in Lagrange County differ from soils formed in a dry, warm climate or from those that formed in a hot, moist climate. Climate is uniform throughout the county, although its effect is modified locally by proximity to large bodies of water. Therefore, only minor differences in the soils of Lagrange County are the results of the differences in climate. For more detailed information on climate of the county, see the section "General nature of the county."

Relief

Relief, or topography, has a marked influence on the soils of Lagrange County through its influence on natural drainage, erosion, plant cover, and soil temperature. In Lagrange County, slope ranges from 0 to 25 percent. Natural soil drainage ranges from well drained on the ridgetops to very poorly drained in the depressions.

Relief influences the formation of soils by affecting runoff and drainage; drainage in turn, through its affect on aeration of the soil, determines the color of the soil. The volume of runoff is more on steep soils than on less sloping soils, and in low areas, water is temporarily ponded. Water and air move freely through soils that are well drained, but slowly through soils that are very poorly drained. In soils that are well aerated the colors are bright, because the iron and aluminum compounds that give most soils their color are oxidized. In soils that are poorly aerated, the color is dull gray and mottled. The Wawasee soils are an example of well drained, well aerated soils, and the Rensselaer soils are an example of poorly aerated, very poorly drained soils.

Time

Time, usually a long time, is required by soil forming processes to change parent material into soil and to form distinct horizons in the soil profile. The differences in length of time that the parent materials have been in place are commonly reflected in the degree of development of the soil profile. Some soils develop rapidly, others develop slowly.

Processes of soil formation

Several processes have been involved in the formation of soils of the county. These processes are the accumulation of organic matter; the solution, transfer, and removal of calcium carbonates and other bases; and the liberation and translocation of silicate clay minerals. In most soils more than one of these processes have been active in horizon differentiation.

Some organic matter has accumulated in the surface layer of all the soils. The organic matter content of some soils is low, but that of others is high. Generally, the soils that have the most organic matter, such as the Sebewa or Rensselaer soils, have a thick, black surface layer.

Carbonates and other bases have been leached from the upper part of nearly all of the soils in the county. Leaching is generally believed to precede the translocation of silicate clay minerals. Most of the carbonates and some of the bases have been leached from the A and B horizons of the well drained soils. Even in the wettest soils, some leaching is indicated by the absence of carbonates and by an acid reaction. Leaching of wet soils is slow because of the high water table or because water moves slowly through such soils.

Clay accumulates in pores and other voids in the soil and forms films on the surfaces along which water moves. Leaching of bases and translocation of silicate clays are among the more important processes in the differentiation of horizons in soils. The Wawasee soils are examples of soils in which translocated silicate clays have accumulated as clay films in the argillic horizon.

The reduction and transfer of iron, or gleying, has occurred in all of the very poorly drained and somewhat poorly drained soils in the county. In the naturally wet soils, this process has been significant in horizon differentiation. The gray color of the subsoil indicates the redistribution of iron oxides. The reduction is commonly accompanied by some transfer of the iron, either from upper horizons to lower horizons, or completely out of the profile. Spots or flecks of one color in the background of another color indicates redistribution and segregation of iron.

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Glossary

ABC soil. A soil having an A, a B, and a C horizon.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	More than 12

Base saturation. The degree to which material having cation exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation exchange capacity.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bottom land. The normal flood plain of a stream, subject to flooding.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

Chiseling. Tillage with an implement having one or more soil-penetrating points that loosen the subsoil and bring clods to the surface. A form of emergency tillage to control soil blowing.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Coarse fragments. Mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter.

Coarse textured soil. Sand or loamy sand.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.5 to 25 centimeters) in diameter.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures on a complex slope is difficult.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping (or contour farming). Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Depth to rock. Bedrock is too near the surface for the specified use.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drain-

age or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically for long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Esker (geology). A narrow, winding ridge of stratified gravelly and sandy drift deposited by a stream flowing in a tunnel beneath a glacier.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Fine textured soil. Sandy clay, silty clay, and clay.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Glacial drift (geology). Pulverized and other rock material transported by glacial ice and then deposited. Also the sorted and unsorted material deposited by streams flowing from glaciers.

Glacial outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by glacial melt water.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Glaciofluvial deposits (geology). Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur as kames, eskers, deltas, and outwash plains.

Glaciolacustrine deposits. Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes mainly by glacial melt water. Many deposits are interbedded or laminated.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.5 centimeters) in diameter.

Green manure (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric and the more decomposed sapric material.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual*. The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue at the surface of a mineral soil.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.
Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.
Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.
Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.
Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.
Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.
Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.
Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Kame (geology). An irregular, short ridge or hill of stratified glacial drift.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Large stones (in tables). Rock fragments 3 inches (7.5 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Moderately coarse textured soil. Sandy loam and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Some types are terminal, lateral, medial, and ground.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Muck. Dark colored, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Outwash, glacial. Stratified sand and gravel produced by glaciers and carried, sorted, and deposited by glacial melt water.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Peat. Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture. (See Fibric soil material.)

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.20 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, differences in slope, stoniness, and thickness.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Poor outlets (in tables). Refers to areas where surface or subsurface drainage outlets are difficult or expensive to install.

Productivity (soil). The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called groundwater runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and runoff water.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slow intake (in tables). The slow movement of water into the soil.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 mm in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	Less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Technically, the A2 horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt, silt loam, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Till plain. An extensive flat to undulating area underlain by glacial till.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the low lands along streams.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

TABLES

TABLE 1--TEMPERATURE AND PRECIPITATION

[Recorded in the period 1951-74 at Goshen, Indiana]

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average daily	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days[1]	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January----	31.6	16.7	24.2	58	-12	10	1.78	.91	2.48	4	7.1
February---	35.5	19.5	27.5	59	-10	9	1.59	.82	2.22	4	7.1
March------	45.1	27.4	36.3	76	2	75	2.33	1.51	3.07	6	5.5
April------	59.8	38.2	49.0	82	19	277	3.65	2.24	4.90	9	2.2
May--------	70.4	47.9	59.2	89	28	595	3.04	2.23	3.79	7	.1
June-------	80.6	57.8	69.2	96	40	876	3.46	2.15	4.63	7	.0
July-------	83.7	61.5	72.7	97	46	1,014	3.79	2.01	5.23	6	.0
August-----	82.2	59.5	70.9	95	43	958	3.08	1.77	4.14	6	.0
September--	75.7	52.6	64.2	93	32	726	3.02	1.46	4.28	6	.0
October----	64.4	42.4	53.5	84	23	424	2.85	1.21	4.18	6	.6
November---	48.3	32.2	40.3	72	10	91	2.28	1.48	3.01	6	3.4
December---	36.1	22.3	29.2	62	-8	24	2.12	.92	3.08	5	6.5
Year-----	59.5	39.8	49.7	99	-14	5,079	32.99	28.18	37.62	72	32.5

[1]A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (60° F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

[Recorded in the period 1951-74 at Goshen, Indiana]

Probability	Temperature		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	April 18	April 30	May 19
2 years in 10 later than--	April 15	April 25	May 14
5 years in 10 later than--	April 7	April 17	May 3
First freezing temperature in fall:			
1 year in 10 earlier than--	October 25	October 8	September 23
2 years in 10 earlier than--	October 29	October 13	September 29
5 years in 10 earlier than--	November 6	October 24	October 9

TABLE 3.--GROWING SEASON

[Recorded in the period 1951-74 at Goshen, Indiana]

Probability	Daily minimum temperature during growing season		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	195	172	139
8 years in 10	201	178	146
5 years in 10	212	190	158
2 years in 10	223	201	171
1 year in 10	228	207	177

TABLE 4.--SUITABILITY AND LIMITATIONS OF GENERAL SOIL MAP UNITS FOR SPECIFIED USES

Map unit	Extent of area	Cultivated crops	Specialty crops	Woodland	Urban uses	Intensive recreation areas	Extensive recreation areas
	Pct						
Wawasee-Hillsdale-Conover	34	Good	Good	Good	Good	Good	Good.
Boyer-Oshtemo	30	Fair: low available water capacity.	Good	Good	Good	Good	Good.
Sebewa-Gilford-Homer	10	Good	Fair: wetness.	Fair: wetness.	Poor: wetness.	Poor: wetness.	Poor: wetness.
Plainfield-Gilford	8	Poor: low available water capacity.	Good	Fair: low available water capacity.	Good	Fair: too sandy.	Fair: too sandy.
Shipshe-Parr	7	Fair: low available water capacity.	Good	Good	Good	Good	Good.
Houghton-Adrian	6	Fair: wetness.	Fair: wetness.	Poor: wetness.	Poor: wetness.	Poor: wetness	Poor: wetness.
Blount-Pewamo	3	Good	Fair: wetness.	Fair: wetness.	Poor: wetness.	Poor: wetness.	Poor: wetness.
Rawson-Morley	2	Good	Fair: too clayey.	Good	Fair: too clayey.	Good	Good.

TABLE 5.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
Ad	Adrian muck	2,791	1.2
Am	Adrian muck, drained	3,101	1.3
BaA	Blount silt loam, 0 to 3 percent slopes	3,943	1.6
BoA	Boyer loamy sand, 0 to 2 percent slopes	11,614	4.8
BoB	Boyer loamy sand, 2 to 6 percent slopes	15,740	6.5
BoC	Boyer loamy sand, 6 to 12 percent slopes	6,658	2.7
BoD	Boyer loamy sand, 12 to 18 percent slopes	1,486	0.6
Bp	Brady sandy loam	3,935	1.6
BtA	Brems sand, 0 to 3 percent slopes	359	0.1
BxA	Bronson sandy loam, 0 to 3 percent slopes	2,594	1.1
ChB	Chelsea fine sand, 1 to 6 percent slopes	3,175	1.3
ChC	Chelsea fine sand, 6 to 12 percent slopes	1,274	0.5
CrA	Conover loam, 0 to 3 percent slopes	11,427	4.7
Ed	Edwards muck	1,297	0.5
Gf	Gilford sandy loam	9,026	3.7
Gr	Granby loamy fine sand	1,088	0.4
HaA	Haskins loam, 0 to 3 percent slopes	1,467	0.6
HdA	Hillsdale sandy loam, 0 to 2 percent slopes	1,416	0.6
HdB	Hillsdale sandy loam, 2 to 6 percent slopes	10,389	4.3
HdC	Hillsdale sandy loam, 6 to 12 percent slopes	3,444	1.4
Ho	Homer sandy loam	5,728	2.4
Ht	Houghton muck	7,195	3.0
Hw	Houghton muck, drained	2,889	1.2
Hx	Houghton muck, ponded	3,845	1.6
MbB	Martinsville sandy loam, 1 to 6 percent slopes	498	0.2
Mc	Martisco muck	487	0.2
MeB	Metea loamy sand, 2 to 6 percent slopes	3,233	1.3
MeC	Metea loamy sand, 6 to 12 percent slopes	924	0.4
MoB2	Morley loam, 2 to 6 percent slopes, eroded	311	0.1
MoC2	Morley loam, 6 to 14 percent slopes, eroded	286	0.1
NaA	Nappanee silt loam, 0 to 3 percent slopes	1,117	0.5
OsA	Oshtemo loamy sand, 0 to 2 percent slopes	10,010	4.1
OsB	Oshtemo loamy sand, 2 to 6 percent slopes	12,418	5.1
OsC	Oshtemo loamy sand, 6 to 12 percent slopes	4,809	2.0
OsD	Oshtemo loamy sand, 12 to 18 percent slopes	986	0.4
OsE	Oshtemo loamy sand, 18 to 25 percent slopes	560	0.2
OuB	Oshtemo-Hillsdale-Chelsea complex, 3 to 6 percent slopes	1,566	0.6
OuC	Oshtemo-Hillsdale-Chelsea complex, 6 to 12 percent slopes	1,074	0.4
Pm	Palms muck, drained	1,458	0.6
PrA	Parr loam, 0 to 2 percent slopes	2,362	1.0
Pt	Pewamo silty clay loam	1,457	0.6
Pv	Pits, gravel	411	0.2
PxB	Plainfield sand, 2 to 6 percent slopes	4,340	1.8
PxC	Plainfield sand, 6 to 12 percent slopes	1,878	0.8
PzA	Plainfield loamy sand, 0 to 2 percent slopes	4,798	2.0
RaB	Rawson sandy loam, 2 to 6 percent slopes	693	0.3
Rb	Rensselaer loam	11,561	4.8
Se	Sebewa loam	13,128	5.4
ShA	Shipshe sandy loam, 0 to 2 percent slopes	10,124	4.2
ShB	Shipshe sandy loam, 2 to 6 percet slopes	2,154	0.9
ShC	Shipshe sandy loam, 6 to 12 percent slopes	570	0.2
Ud	Udorthents, loamy	1,061	0.4
Wa	Wallkill silt loam	244	0.1
WeA	Wawasee fine sandy loam, 0 to 2 percent slopes	2,305	1.0
WeB	Wawasee fine sandy loam, 2 to 6 percent slopes	15,195	6.3
WeC2	Wawasee fine sandy loam, 6 to 12 percent slopes, eroded	4,981	2.1
WeD2	Wawasee fine sandy loam, 12 to 18 percent slopes, eroded	1,010	0.4
WhC3	Wawasee loam, 6 to 12 percent slopes, severely eroded	1,161	0.5
WhD3	Wawasee loam, 12 to 18 percent slopes, severely eroded	482	0.2
Wt	Whitaker sandy loam	1,662	0.7
	Water	5,365	2.2
	Total	242,560	100.0

TABLE 6.--YIELDS PER ACRE OF CROPS AND PASTURE

[Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Soil name and map symbol	Corn	Soybeans	Winter wheat	Grass-legume hay	Tall fescue
	Bu	Bu	Bu	Ton	AUM*
Ad: Adrian	---	---	---	---	---
Am: Adrian	95	30	---	3.0	6.0
BaA: Blount	100	34	42	4.0	6.6
BoA, BoB: Boyer	70	28	30	2.6	5.2
BoC: Boyer	65	24	28	2.6	5.2
BoD: Boyer	50	21	24	2.0	4.0
Bp: Brady	85	30	35	3.0	6.2
BtA: Brems	70	24	32	2.3	4.6
BxA: Bronson	80	32	35	3.0	6.0
ChB: Chelsea	57	21	---	2.0	4.0
ChC: Chelsea	---	---	---	1.5	3.0
CrA: Conover	120	42	45	3.6	7.2
Ed: Edwards	---	---	---	---	---
Gf: Gilford	120	42	54	4.0	8.0
Gr: Granby	85	30	35	3.0	6.0
HaA: Haskins	110	44	46	4.0	8.0
HdA: Hillsdale	100	35	45	4.0	8.0
HdB: Hillsdale	95	35	40	4.0	8.0
HdC: Hillsdale	80	32	35	3.6	7.2
Ho: Homer	95	33	48	3.1	6.2
Ht: Houghton	---	---	---	---	---

See footnotes at end of table.

TABLE 6.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Soybeans	Winter wheat	Grass-legume hay	Tall fescue
	Bu	Bu	Bu	Ton	AUM*
Hw: Houghton	120	34	---	3.0	6.0
Hx: Houghton	---	---	---	---	---
MbB: Martinsville	115	40	46	3.8	7.6
Mc: Martisco	90	---	---	2.8	5.6
MeB: Metea	85	30	42	2.8	5.6
MeC: Metea	75	26	38	2.5	5.0
MoB2: Morley	90	33	41	3.6	7.2
MoC2: Morley	82	28	36	3.4	6.8
NaA: Nappanee	90	32	37	3.5	7.0
OsA, OsB: Oshtemo	80	28	30	2.1	4.2
OsC: Oshtemo	75	24	28	2.1	4.2
OsD: Oshtemo	60	21	24	1.8	3.6
OsE: Oshtemo	---	---	---	1.5	3.0
OuB: Oshtemo-Hillsdale-Chelsea	80	29	31	2.6	5.2
OuC: Oshtemo-Hillsdale-Chelsea	75	24	28	2.4	4.8
Pm: Palms	120	42	---	3.0	6.0
PrA: Parr	125	42	54	4.0	8.0
Pt: Pewamo	110	40	50	4.0	8.0
Pv**. Pits					
PxB, PxC, PzA: Plainfield	---	---	---	2.0	4.0
RaB: Rawson	100	32	42	4.0	8.0
Rb: Rensselaer	150	53	60	5.0	10.0
Se: Sebewa	105	36	50	4.6	---

See footnotes at end of table.

TABLE 6.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Soybeans	Winter wheat	Grass-legume hay	Tall fescue
	Bu	Bu	Bu	Ton	AUM*
ShA----------------------- Shipshe	85	32	40	3.0	6.0
ShB----------------------- Shipshe	80	32	40	3.0	6.0
ShC----------------------- Shipshe	75	28	36	2.6	5.2
Ud**. Udorthents					
Wa------------------------ Wallkill	120	35	42	3.5	6.5
WeA----------------------- Wawasee	115	39	49	3.5	7.0
WeB----------------------- Wawasee	110	37	47	3.4	6.8
WeC2---------------------- Wawasee	95	33	40	3.1	6.2
WeD2---------------------- Wawasee	90	30	40	3.1	6.0
WhC3---------------------- Wawasee	90	30	40	3.1	6.0
WhD3---------------------- Wawasee	---	---	---	---	5.0
Wt------------------------ Whitaker	125	44	50	4.1	8.2

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--CAPABILITY CLASSES AND SUBCLASSES

[Miscellaneous areas are excluded. Absence of an entry indicates no acreage]

Class	Total acreage*	Major management concerns (Subclass)			
		Erosion (e)	Wetness (w)	Soil problem (s)	Climate (c)
		Acres	Acres	Acres	Acres
I	4,667	---	---	---	---
II	95,888	27,086	64,792	4,010	---
III	94,943	28,133	5,338	61,472	---
IV	16,563	4,643	3,588	8,332	---
V	11,283	---	11,283	---	---
VI	8,534	1,042	---	7,492	---
VII	---	---	---	---	---
VIII	3,845	---	3,845	---	---

*Water areas make up 5,365 acres, and 1,472 acres are not assigned to a capability class.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY

[Only the soils suitable for production of commercial trees are listed. Absence of an entry indicates that information was not available]

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Potential productivity: Common trees	Potential productivity: Site index	Trees to plant
Ad, Am------------- Adrian	4w	Slight	Severe	Severe	Severe	White ash----------- Red maple----------- Quaking aspen------- Black willow-------- Silver maple--------	51 51 56 --- 76	White ash, red maple, silver maple.
BaA---------------- Blount	3o	Slight	Slight	Slight	Slight	White oak----------- Northern red oak---- Green ash----------- Bur oak------------- Pin oak------------- White oak----------- Red pine------------	65 65 --- --- --- 70 78	Eastern white pine, eastern redcedar, red pine, yellow-poplar.
BoA, BoB, BoC, BoD Boyer	3s	Slight	Slight	Moderate	Slight	Eastern white pine-- Jack pine----------- Northern red oak----	85 68 75	Eastern white pine, red pine, jack pine.
Bp----------------- Brady	3o	Slight	Slight	Slight	Slight	White oak----------- Pin oak------------- Eastern white pine-- Quaking aspen-------	70 90 70 85	Red maple, European larch, eastern white pine, American sycamore.
BtA---------------- Brems	3s	Slight	Slight	Severe	Slight	Northern red oak---- Red pine------------ Eastern white pine-- Jack pine-----------	70 72 65 70	Eastern white pine, red pine, jack pine.
BxA---------------- Bronson	3o	Slight	Slight	Slight	Slight	Northern red oak---- Red pine------------ Eastern white pine-- Jack pine-----------	70 72 85 70	Eastern white pine, red pine, jack pine.
ChB, ChC----------- Chelsea	3s	Slight	Slight	Moderate	Slight	White oak----------- Red pine------------ Eastern white pine-- Jack pine----------- Quaking aspen------- Northern red oak----	70 72 83 70 72 70	Eastern white pine, red pine, jack pine.
CrA---------------- Conover	3o	Slight	Slight	Slight	Slight	Northern red oak---- Pin oak------------- Yellow-poplar------- Sweetgum------------	75 85 85 80	Eastern white pine, white ash, red maple, yellow-poplar, American sycamore.
Ed----------------- Edwards	4w	Slight	Severe	Severe	Severe	White ash----------- Red maple----------- Quaking aspen------- Black willow-------- Silver maple--------	51 51 56 --- 76	White ash, red maple, silver maple.
Gf----------------- Gilford	4w	Slight	Severe	Severe	Severe	Pin oak------------- Eastern white pine-- Bigtooth aspen------ Red maple-----------	70 55 70 60	Red maple, silver maple, white ash.
Gr----------------- Granby	4w	Slight	Severe	Severe	Severe	Pin oak------------- Quaking aspen------- Eastern white pine--	70 70 75	Eastern white pine, black spruce.
HaA---------------- Haskins	2o	Slight	Slight	Slight	Slight	White oak----------- Northern red oak---- Pin oak-------------	75 80 90	Red maple, white ash, eastern white pine, yellow-poplar.
HdA, HdB, HdC------ Hillsdale	1o	Slight	Slight	Slight	Slight	White oak----------- Yellow-poplar------- Sweetgum------------	90 98 76	Eastern white pine, red pine, black walnut, yellow-poplar, white ash.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Potential productivity: Common trees	Site index	Trees to plant
Ho------------------ Homer	3o	Slight	Slight	Slight	Slight	White oak-----------	70	Eastern white pine, white ash, red maple, yellow-poplar, American sycamore.
						Pin oak-------------	85	
						Yellow-poplar-------	85	
						Sweetgum------------	80	
Ht, Hw, Hx--------- Houghton	4w	Slight	Severe	Severe	Severe	White ash-----------	51	White ash, red maple, silver maple.
						Red maple-----------	51	
						Quaking aspen-------	56	
						Black willow--------	---	
						Silver maple--------	76	
MbB---------------- Martinsville	1o	Slight	Slight	Slight	Slight	White oak-----------	90	Eastern white pine, red pine, white ash, yellow-poplar, black walnut, black locust.
						Yellow-poplar-------	98	
						Sweetgum------------	76	
Mc------------------ Martisco	5w	Slight	Severe	Severe	Severe	Red maple-----------	55	Red maple.
MeB, MeC----------- Metea	2s	Slight	Slight	Moderate	Slight	White oak-----------	80	Eastern white pine, red pine, yellow-poplar, black walnut.
						Yellow-poplar-------	86	
						Eastern white pine--	75	
						Red pine------------	75	
MoB2, MoC2--------- Morley	2o	Slight	Slight	Slight	Slight	White oak-----------	80	White oak, black walnut, green ash, eastern white pine, Norway spruce, eastern white pine, red pine, white spruce.
						Northern red oak----	80	
						Yellow-poplar-------	90	
						Black walnut--------	---	
						Bur oak-------------	---	
						Northern red oak----	---	
						Shagbark hickory----	---	
						Bur oak-------------	---	
NaA---------------- Nappanee	3c	Slight	Moderate	Severe	Severe	White oak-----------	75	Eastern white pine, white ash, red maple, yellow-poplar, American sycamore.
						Pin oak-------------	85	
						Sweetgum------------	80	
						American sycamore---	---	
						Blackgum------------	---	
OsA, OsB, OsC, OsD Oshtemo	3s	Slight	Slight	Moderate	Slight	Northern red oak----	66	Eastern white pine, red pine, white spruce, jack pine.
						White oak-----------	---	
						American basswood---	66	
						Sugar maple---------	61	
OsE---------------- Oshtemo	3s	Moderate	Moderate	Moderate	Slight	Northern red oak----	66	Eastern white pine, red pine, white spruce, jack pine.
						White oak-----------	---	
						American basswood---	66	
						Sugar maple---------	61	
OuB*, OuC*:								
Oshtemo-----------	3s	Slight	Slight	Moderate	Slight	Northern red oak----	66	Eastern white pine, red pine, white spruce, jack pine.
						White oak-----------	---	
						American basswood---	66	
						Sugar maple---------	61	
Hillsdale---------	1o	Slight	Slight	Slight	Slight	White oak-----------	90	Eastern white pine, red pine, black walnut, yellow-poplar, white ash.
						Yellow-poplar-------	98	
						Sweetgum------------	76	
Chelsea-----------	3s	Slight	Slight	Moderate	Slight	White oak-----------	70	Eastern white pine, red pine, jack pine.
						Red pine------------	72	
						Eastern white pine--	83	
						Jack pine-----------	70	
						Quaking aspen-------	72	
						Northern red oak----	70	

See footnote at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Potential productivity: Common trees	Potential productivity: Site index	Trees to plant
Pm: Palms	4w	Slight	Severe	Severe	Severe	White ash Red maple Quaking aspen Black willow Silver maple	51 51 56 --- 76	White ash, red maple, silver maple.
PrA: Parr	---	--------	--------	--------	--------		---	Eastern white pine, red pine, white ash, yellow-poplar, black walnut.
Pt: Pewamo	2w	Slight	Severe	Moderate	Moderate	Pin oak Swamp white oak Red maple White ash Eastern cottonwood Green ash	90 --- 71 71 98 ---	Norway spruce, white ash, eastern white pine, red maple, green ash.
PxB, PxC, PzA: Plainfield	3s	Slight	Slight	Severe	Slight	Black oak White oak Black cherry Scarlet oak Northern red oak	70 65 --- 68 ---	Red pine, eastern white pine, jack pine.
RaB: Rawson	2o	Slight	Slight	Slight	Slight	White oak Northern red oak	75 80	Eastern white pine, yellow-poplar, black walnut.
Rb: Rensselaer	2w	Slight	Severe	Severe	Severe	Pin oak White oak Sweetgum Northern red oak	86 75 90 76	Eastern white pine, red maple, white ash, sweetgum.
Se: Sebewa	2w	Slight	Severe	Severe	Severe	Pin oak White ash White oak Red maple American basswood	88 75 72 --- ---	Eastern white pine, white ash, green ash, Norway spruce.
ShA, ShB, ShC: Shipshe	---	--------	--------	--------	--------		---	Eastern white pine, red pine, black walnut, white ash.
Wa: Wallkill	4w	Slight	Severe	Severe	Severe	Pin oak Red maple	80 65	Red maple, white ash, silver maple.
WeA, WeB, WeC2, WeD2, WhC3, WhD3. Wawasee	1o	Slight	Slight	Slight	Slight	White oak Yellow-poplar Sweetgum	90 98 72	Eastern white pine, red pine, white ash, yellow-poplar, black walnut.
Wt: Whitaker	3o	Slight	Slight	Slight	Slight	White oak Pin oak Yellow-poplar Sweetgum Northern red oak	70 85 85 80 75	Eastern white pine, white ash, red maple, yellow-poplar, American sycamore.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil]

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
Ad, Am: Adrian	Gray dogwood, dwarf purple willow.	Amur honeysuckle, redosier dogwood, silky dogwood.	Tall purple willow, medium purple willow.	Northern white-cedar.	Lombardy poplar.
BaA: Blount	Gray dogwood, redosier dogwood, arrowwood.	Autumn-olive, silky dogwood.	Amur maple, eastern redcedar, flowering dogwood.	Norway spruce, eastern white pine, Douglas-fir.	Eastern cottonwood.
BoA, BoB, BoC, BoD. Boyer	American hazel, European privet.	Tamarisk, late lilac, forsythia, autumn-olive.	Austrian pine, tall purple willow.	Eastern white pine, red pine, jack pine.	---
Bp: Brady	Gray dogwood, dwarf purple willow.	Redosier dogwood, silky dogwood.	Tall purple willow	Eastern white pine, pin oak.	---
BtA: Brems	American hazel, European privet.	Tamarisk, late lilac, forsythia, autumn-olive.	Austrian pine, tall purple willow.	Eastern white pine, red pine, jack pine.	---
BxA: Bronson	American hazel, European privet.	Tamarisk, late lilac, forsythia.	Red pine, Austrian pine.	Eastern white pine, jack pine, tall purple willow, autumn-olive.	---
ChB, ChC: Chelsea	Russian peashrub, gray dogwood, Koster redcedar.	Eastern redcedar, Russian-olive, Siberian crabapple, nannyberry viburnum.	Common hackberry, eastern white pine, red pine.	---	---
CrA: Conover	Cutleaf staghorn sumac.	Blackhaw, arrowwood, cornelian cherry dogwood, rose-of-sharon, Amur honeysuckle, American cranberrybush, autumn-olive.	---	American basswood, Norway spruce, white spruce.	Eastern white pine.
Ed: Edwards	Gray dogwood, dwarf purple willow.	Amur honeysuckle, redosier dogwood, silky dogwood.	Northern white-cedar, tall purple willow, medium purple willow.	---	Lombardy poplar.
Gf: Gilford	Gray dogwood, dwarf purple willow.	Redosier dogwood, hawthorn, silky dogwood, shadblow serviceberry.	Northern white-cedar, tall purple willow, laurel willow.	Pin oak, eastern white pine.	Lombardy poplar.
Gr: Granby	Gray dogwood, dwarf purple willow.	Redosier dogwood, silky dogwood.	Tall purple willow	---	---
HaA: Haskins	Cutleaf staghorn sumac.	Arrowwood, cornelian cherry dogwood, rose-of-sharon, Amur honeysuckle, American cranberrybush, autumn-olive.	Blackhaw	American basswood, Norway spruce, white spruce.	Eastern white pine.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
HdA, HdB, HdC: Hillsdale	American hazel, European privet.	Tamarisk, late lilac, forsythia, autumn-olive.	Austrian pine	Eastern white pine, red pine, jack pine.	---
Ho: Homer	Cutleaf staghorn sumac.	Blackhaw, arrowwood, cornelian cherry dogwood, rose-of-sharon, Amur honeysuckle, American cranberrybush, autumn-olive.	---	American basswood, Norway spruce, white spruce.	Eastern white pine.
Ht, Hw: Houghton	Gray dogwood, dwarf purple willow.	Amur honeysuckle, redosier dogwood, silky dogwood.	Northern white-cedar, tall purple willow, medium purple willow.	---	Lombardy poplar.
Hx. Houghton					
MbB: Martinsville	Mockorange	European burningbush, blackhaw, late lilac, Amur honeysuckle, shadblow serviceberry, American cranberrybush, autumn-olive.	Eastern hemlock	Norway spruce	Eastern white pine, honeylocust.
Mc: Martisco	Gray dogwood, dwarf purple willow.	Amur honeysuckle, redosier dogwood, silky dogwood.	Northern white-cedar, tall purple willow, medium purple willow.	---	Lombardy poplar.
MeB, MeC: Metea	American hazel, European privet.	Forsythia, late lilac, tamarisk, autumn-olive.	---	Red pine, eastern white pine, jack pine, Austrian pine.	---
MoB2, MoC2: Morley	Mockorange	Blackhaw, late lilac, American cranberrybush, autumn-olive.	Eastern red cedar	Eastern white pine, Norway spruce, red pine, eastern hemlock.	---
NaA: Nappanee	Silky dogwood, dwarf purple willow.	Redosier dogwood	Eastern white pine, tall purple willow.	---	---
OsA, OsB, OsC, OsD, OsE. Oshtemo	American hazel, European privet.	Tamarisk, late lilac, forsythia, autumn-olive.	---	Eastern white pine, red pine, Austrian pine, jack pine.	---
OuB*, OuC*:					
Oshtemo	American hazel, European privet.	Tamarisk, late lilac, forsythia, autumn-olive.	---	Eastern white pine, red pine, Austrian pine, jack pine.	---
Hillsdale	American hazel, European privet.	Tamarisk, late lilac, forsythia, autumn-olive.	Austrian pine	Eastern white pine, red pine, jack pine.	---

See footnote at end of table.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of-- <8	8-15	16-25	26-35	>35
OuB*, OuC*:					
Chelsea	Russian peashrub, gray dogwood, Koster redcedar.	Eastern redcedar, Russian-olive, Siberian crabapple, nannyberry viburnum.	Common hackberry, eastern white pine, red pine.	---	---
Pm. Palms	Gray dogwood, dwarf purple willow.	Amur honeysuckle, redosier dogwood, silky dogwood.	Northern white-cedar, tall purple willow, medium purple willow.	---	Lombardy poplar.
PrA. Parr	Mockorange	European burningbush, blackhaw, late lilac, Amur honeysuckle, shadblow serviceberry, American cranberrybush, autumn-olive.	Eastern hemlock	Norway spruce	Eastern white pine, honeylocust.
Pt. Pewamo	Gray dogwood, dwarf purple willow.	Amur honeysuckle, redosier dogwood, silky dogwood.	Northern white-cedar, tall purple willow, medium purple willow.	---	Lombardy poplar.
Pv*. Pits					
PxB, PxC, PzA. Plainfield	American hazel	Tamarisk, late lilac, forsythia, autumn-olive.	---	Eastern white pine, red pine, Austrian pine, jack pine.	---
RaB. Rawson	Mockorange	European burningbush, blackhaw, late lilac, Amur honeysuckle, shadblow serviceberry, American cranberrybush, autumn-olive.	Eastern hemlock	Norway spruce	Honeylocust, eastern white pine.
Rb. Rensselaer	Gray dogwood, dwarf purple willow.	Redosier dogwood, Amur honeysuckle, silky dogwood.	Northern white-cedar, medium purple willow, tall purple willow.	---	Lombardy poplar.
Se. Sebewa	Gray dogwood, dwarf purple willow.	Amur honeysuckle, redosier dogwood, silky dogwood.	Northern white-cedar, tall purple willow, medium purple willow.	---	Lombardy poplar.

See footnote at end of table.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
ShA, ShB, ShC. Shipshe	Mockorange	European burningbush, blackhaw, late lilac, Amur honeysuckle, shadblow serviceberry, American cranberrybush, autumn-olive.	Eastern hemlock	Norway spruce	Eastern white pine, honeylocust.
Ud*. Udorthents					
Wa. Wallkill	Gray dogwood, dwarf purple willow.	Amur honeysuckle, redosier dogwood, silky dogwood.	Northern white-cedar, tall purple willow, medium purple willow.	---	Lombardy poplar.
WeA, WeB, WeC2, WeD2, WhC3, WhD3. Wawasee	---	Blackhaw, late lilac, Amur honeysuckle, shadblow serviceberry, winged euonymus, American cranberrybush, autumn-olive.	Eastern hemlock, European burningbush.	Norway spruce	Honeylocust, eastern white pine.
Wt. Whitaker	---	Autumn-olive, Amur honeysuckle, American cranberrybush, blackhaw, shadblow serviceberry, arrowwood, cornelian cherry dogwood, rose-of-sharon.	---	Norway spruce, white spruce, American basswood.	Eastern white pine.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Ad, Am: Adrian	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
BaA: Blount	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.
BoA, BoB: Boyer	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Slight.
BoC: Boyer	Moderate: slope, small stones.	Moderate: slope, small stones.	Severe: slope, small stones.	Slight.
BoD: Boyer	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Moderate: slope.
Bp: Brady	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.
BtA: Brems	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
BxA: Bronson	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight.
ChB: Chelsea	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
ChC: Chelsea	Severe: too sandy.	Severe: too sandy.	Severe: too sandy, slope.	Severe: too sandy.
CrA: Conover	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.
Ed: Edwards	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.
Gf: Gilford	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Gr: Granby	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
HaA: Haskins	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: wetness, percs slowly.	Moderate: wetness.
HdA: Hillsdale	Slight	Slight	Moderate: small stones.	Slight.
HdB: Hillsdale	Slight	Slight	Moderate: slope, small stones.	Slight.
HdC: Hillsdale	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.

TABLE 10.--RECREATIONAL DEVELOPMENT--*Continued*

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Ho-------------------- Homer	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.
Ht, Hw---------------- Houghton	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
Hx-------------------- Houghton	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.
MbB------------------- Martinsville	Slight---------------	Slight---------------	Moderate: slope.	Slight.
Mc-------------------- Martisco	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
MeB------------------- Metea	Slight---------------	Slight---------------	Moderate: slope.	Slight.
MeC------------------- Metea	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
MoB2------------------ Morley	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: percs slowly, slope.	Slight.
MoC2------------------ Morley	Moderate: percs slowly, slope.	Moderate: slope, percs slowly.	Severe: slope.	Slight.
NaA------------------- Nappanee	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: wetness, percs slowly.	Severe: erodes easily.
OsA, OsB-------------- Oshtemo	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Slight.
OsC------------------- Oshtemo	Moderate: slope, small stones.	Moderate: slope, small stones.	Severe: slope, small stones.	Slight.
OsD, OsE-------------- Oshtemo	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Moderate: slope.
OuB*:				
Oshtemo---------------	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Slight.
Hillsdale-------------	Slight---------------	Slight---------------	Moderate: slope, small stones.	Slight.
Chelsea---------------	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
OuC*:				
Oshtemo---------------	Moderate: slope, small stones.	Moderate: slope, small stones.	Severe: slope, small stones.	Slight.
Hillsdale-------------	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Chelsea---------------	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.

See footnote at end of table.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Pm: Palms	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
PrA: Parr	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: percs slowly.	Slight.
Pt: Pewamo	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Pv*. Pits				
PxB: Plainfield	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
PxC: Plainfield	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.
PzA: Plainfield	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
RaB: Rawson	Severe: percs slowly.	Severe: percs slowly.	Severe: percs slowly.	Slight.
Rb: Rensselaer	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Se: Sebewa	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
ShA: Shipshe	Slight	Slight	Moderate: small stones.	Slight.
ShB: Shipshe	Slight	Slight	Moderate: slope, small stones.	Slight.
ShC: Shipshe	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Ud*. Udorthents				
Wa: Wallkill	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
WeA: Wawasee	Slight	Slight	Moderate: small stones.	Slight.
WeB: Wawasee	Slight	Slight	Moderate: slope, small stones.	Slight.
WeC2: Wawasee	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
WeD2: Wawasee	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
WhC3: Wawasee	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.

See footnote at end of table.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
WhD3: Wawasee	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
Wt: Whitaker	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--WILDLIFE HABITAT

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
Ad, Am------------- Adrian	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
BaA---------------- Blount	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
BoA, BoB, BoC, BoD Boyer	Poor	Fair	Good	Good	Good	Very poor	Very poor	Fair	Good	Very poor.
Bp----------------- Brady	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
BtA---------------- Brems	Poor	Poor	Fair	Poor	Poor	Poor	Very poor	Poor	Poor	Poor.
BxA---------------- Bronson	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Very poor.
ChB---------------- Chelsea	Poor	Fair	Fair	Poor	Poor	Very poor	Very poor	Fair	Poor	Very poor.
ChC---------------- Chelsea	Very poor	Fair	Fair	Poor	Poor	Very poor	Very poor	Poor	Poor	Very poor.
CrA---------------- Conover	Good	Good	Good	Good	Fair	Fair	Fair	Good	Good	Fair.
Ed----------------- Edwards	Fair	Fair	Poor	Poor	Poor	Good	Good	Fair	Poor	Good.
Gf----------------- Gilford	Fair	Poor	Poor	Poor	Poor	Good	Good	Fair	Poor	Good.
Gr----------------- Granby	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
HaA---------------- Haskins	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
HdA, HdB----------- Hillsdale	Good	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
HdC---------------- Hillsdale	Fair	Good	Good	Good	Good	Very poor	Very poor	Good	Good	Very poor.
Ho----------------- Homer	Fair	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
Ht, Hw------------- Houghton	Fair	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
Hx----------------- Houghton	Very poor	Poor	Very poor	Very poor	Very poor	Good	Good	Very poor	Very poor	Good.
MbB---------------- Martinsville	Good	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
Mc----------------- Martisco	Very poor	Poor	Very poor	Very poor	Very poor	Good	Good	Very poor	Very poor	Good.
MeB---------------- Metea	Poor	Fair	Good	Good	Good	Poor	Very poor	Fair	Good	Very poor.

TABLE 11.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba-ceous plants	Hardwood trees	Conif-erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
MeC: Metea	Poor	Fair	Good	Good	Good	Very poor	Very poor	Fair	Good	Very poor.
MoB2: Morley	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
MoC2: Morley	Fair	Good	Good	Good	Good	Very poor	Very poor	Good	Good	Very poor.
NaA: Nappanee	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
OsA, OsB, OsC, OsD, OsE. Oshtemo	Poor	Fair	Good	Good	Good	Very poor	Very poor	Fair	Good	Very poor.
OuB*:										
Oshtemo	Poor	Fair	Good	Good	Good	Very poor	Very poor	Fair	Good	Very poor.
Hillsdale	Good	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
Chelsea	Poor	Fair	Fair	Poor	Poor	Very poor	Very poor	Fair	Poor	Very poor.
OuC*:										
Oshtemo	Poor	Fair	Good	Good	Good	Very poor	Very poor	Fair	Good	Very poor.
Hillsdale	Fair	Good	Good	Good	Good	Very poor	Very poor	Good	Good	Very poor.
Chelsea	Very poor	Fair	Fair	Poor	Poor	Very poor	Very poor	Poor	Poor	Very poor.
Pm: Palms	Good	Poor	Poor	Poor	Poor	Good	Good	Fair	Poor	Poor.
PrA: Parr	Good	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
Pt: Pewamo	Good	Fair	Fair	Fair	Fair	---	Good	Fair	Fair	Good.
Pv*. Pits										
PxB: Plainfield	Poor	Poor	Fair	Poor	Poor	Very poor	Very poor	Poor	Poor	Very poor.
PxC: Plainfield	Very poor	Poor	Fair	Poor	Poor	Very poor	Very poor	Poor	Poor	Very poor.
PzA: Plainfield	Poor	Poor	Fair	Poor	Poor	Very poor	Very poor	Poor	Poor	Very poor.
RaB: Rawson	Good	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
Rb: Rensselaer	Fair	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
Se: Sebewa	Good	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.

See footnote at end of table.

TABLE 11.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife
ShA, ShB: Shipshe	Fair	Good	Good	Fair	Fair	Poor	Very poor	Good	Fair	Very poor.
ShC: Shipshe	Fair	Good	Good	Fair	Fair	Very poor	Very poor	Good	Fair	Very poor.
Ud*. Udorthents										
Wa: Wallkill	Very poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
WeA, WeB: Wawasee	Good	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
WeC2: Wawasee	Fair	Good	Good	Good	Good	Very poor	Very poor	Good	Good	Very poor.
WeD2: Wawasee	Poor	Good	Good	Good	Good	Very poor	Very poor	Fair	Good	Very poor.
WhC3: Wawasee	Fair	Good	Good	Good	Good	Very poor	Very poor	Good	Good	Very poor.
WhD3: Wawasee	Poor	Good	Good	Good	Good	Very poor	Very poor	Fair	Good	Very poor.
Wt: Whitaker	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Ad, Am------------ Adrian	Severe: ponding, cutbanks cave, excess humus.	Severe: ponding, low strength.	Severe: ponding.	Severe: ponding, low strength.	Severe: ponding, frost action, low strength.
BaA--------------- Blount	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action, low strength.
BoA, BoB---------- Boyer	Severe: cutbanks cave.	Slight-----------	Slight-----------	Slight------------	Slight.
BoC--------------- Boyer	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
BoD--------------- Boyer	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Bp---------------- Brady	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.
BtA--------------- Brems	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
BxA--------------- Bronson	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action.
ChB--------------- Chelsea	Severe: cutbanks cave.	Slight-----------	Slight-----------	Slight------------	Slight.
ChC--------------- Chelsea	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
CrA--------------- Conover	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.
Ed---------------- Edwards	Severe: ponding, excess humus.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, low strength, frost action.
Gf---------------- Gilford	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.
Gr---------------- Granby	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
HaA--------------- Haskins	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: frost action, low strength, wetness.
HdA--------------- Hillsdale	Moderate: rooting depth.	Slight-----------	Slight-----------	Slight------------	Moderate: frost action.
HdB--------------- Hillsdale	Moderate: rooting depth.	Slight-----------	Slight-----------	Moderate: slope.	Moderate: frost action.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
HdC---------------- Hillsdale	Moderate: rooting depth, slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.
Ho----------------- Homer	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.
Ht, Hw------------- Houghton	Severe: ponding, excess humus.	Severe: ponding, low strength.	Severe: ponding, wetness.	Severe: ponding, low strength.	Severe: ponding, low strength.
Hx----------------- Houghton	Severe: excess humus, ponding.	Severe: ponding, low strength.	Severe: ponding.	Severe: ponding, low strength.	Severe: ponding, frost action.
MbB---------------- Martinsville	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: low strength, frost action.
Mc----------------- Martisco	Severe: ponding, excess humus.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
MeB---------------- Metea	Severe: cutbanks cave.	Slight-----------	Slight-----------	Moderate: slope.	Moderate: frost action.
MeC---------------- Metea	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.
MoB2--------------- Morley	Moderate: too clayey, wetness.	Moderate: shrink-swell.	Moderate: shrink-swell, wetness.	Moderate: shrink-swell.	Severe: low strength.
MoC2--------------- Morley	Moderate: too clayey, slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell, wetness.	Severe: slope.	Severe: low strength.
NaA---------------- Nappanee	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, shrink-swell.
OsA---------------- Oshtemo	Severe: cutbanks cave.	Slight-----------	Slight-----------	Slight-------------	Slight.
OsB---------------- Oshtemo	Severe: cutbanks cave.	Slight-----------	Slight-----------	Moderate: slope.	Slight.
OsC---------------- Oshtemo	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
OsD, OsE----------- Oshtemo	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
OuB*:					
Oshtemo-----------	Severe: cutbanks cave.	Slight-----------	Slight-----------	Moderate: slope.	Slight.
Hillsdale---------	Moderate: rooting depth.	Slight-----------	Slight-----------	Moderate: slope.	Moderate: frost action.
Chelsea-----------	Severe: cutbanks cave.	Slight-----------	Slight-----------	Moderate: slope.	Slight.

See footnote at end of table.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
OuC*:					
Oshtemo	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
Hillsdale	Moderate: rooting depth, slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.
Chelsea	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
Pm Palms	Severe: ponding, excess humus.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, frost action, low strength.
PrA Parr	Slight	Moderate: shrink-swell.	Slight	Moderate: shrink-swell.	Severe: low strength.
Pt Pewamo	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, frost action, ponding.
Pv*. Pits					
PxB Plainfield	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight.
PxC Plainfield	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
PzA Plainfield	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
RaB Rawson	Moderate: wetness, too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength.
Rb Rensselaer	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding, frost action.
Se Sebewa	Severe: ponding, cutbanks cave.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.
ShA Shipshe	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: frost action.
ShB Shipshe	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Moderate: frost action.
ShC Shipshe	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.
Ud*. Udorthents					
Wa Wallkill	Severe: ponding.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, low strength.

See footnote at end of table.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
WeA----------------Wawasee	Slight-----------	Slight-----------	Slight-----------	Slight------------	Moderate: frost action.
WeB----------------Wawasee	Slight-----------	Slight-----------	Slight-----------	Moderate: slope.	Moderate: frost action.
WeC2--------------Wawasee	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.
WeD2--------------Wawasee	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
WhC3--------------Wawasee	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.
WhD3--------------Wawasee	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Wt-----------------Whitaker	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Ad, Am------ Adrian	Severe: ponding.	Severe: seepage, ponding, excess humus.	Severe: ponding, seepage.	Severe: ponding, seepage.	Poor: ponding, excess humus.
BaA------ Blount	Severe: wetness, percs slowly.	Slight------	Severe: wetness.	Severe: wetness.	Poor: wetness.
BoA, BoB------ Boyer	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
BoC------ Boyer	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
BoD------ Boyer	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
Bp------ Brady	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: wetness.
BtA------ Brems	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
BxA------ Bronson	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: seepage.
ChB------ Chelsea	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
ChC------ Chelsea	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
CrA------ Conover	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
Ed------ Edwards	Severe: ponding, percs slowly.	Severe: ponding, seepage, excess humus.	Severe: ponding.	Severe: ponding, seepage.	Poor: ponding.
Gf------ Gilford	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
Gr------ Granby	Severe: ponding, poor filter.	Severe: ponding, wetness.	Severe: ponding, seepage, too sandy.	Severe: ponding, seepage.	Poor: seepage, too sandy, ponding.

TABLE 13.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
HaA----------------- Haskins	Severe: percs slowly, wetness.	Slight-----------	Severe: wetness, too clayey.	Severe: wetness.	Poor: wetness.
HdA, HdB------------ Hillsdale	Moderate: percs slowly.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
HdC----------------- Hillsdale	Moderate: percs slowly, slope.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Fair: slope.
Ho------------------ Homer	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, small stones.
Ht, Hw-------------- Houghton	Severe: ponding, percs slowly.	Severe: seepage, ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, seepage.	Poor: ponding, excess humus.
Hx------------------ Houghton	Severe: ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus.
MbB----------------- Martinsville	Slight-----------	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey, thin layer.
Mc------------------ Martisco	Severe: ponding, percs slowly.	Severe: ponding, excess humus.	Severe: ponding.	Severe: ponding.	Poor: ponding, excess humus.
MeB----------------- Metea	Moderate: percs slowly.	Severe: seepage.	Severe: too sandy.	Severe: seepage.	Poor: seepage, too sandy.
MeC----------------- Metea	Moderate: slope, percs slowly.	Severe: seepage, slope.	Severe: too sandy.	Severe: seepage.	Poor: seepage, too sandy.
MoB2---------------- Morley	Severe: percs slowly, wetness.	Severe: wetness.	Moderate: too clayey, wetness.	Slight-----------	Fair: too clayey.
MoC2---------------- Morley	Severe: percs slowly, wetness.	Severe: slope, wetness.	Moderate: slope, too clayey, wetness.	Moderate: slope.	Fair: too clayey, slope.
NaA----------------- Nappanee	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
OsA, OsB------------ Oshtemo	Severe: poor filter.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: seepage.
OsC----------------- Oshtemo	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Poor: seepage.
OsD, OsE------------ Oshtemo	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: seepage, slope.

See footnote at end of table.

TABLE 13.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
OuB*:					
Oshtemo	Severe: poor filter.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: seepage.
Hillsdale	Moderate: percs slowly.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
Chelsea	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
OuC*:					
Oshtemo	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Poor: seepage.
Hillsdale	Moderate: percs slowly, slope.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Fair: slope.
Chelsea	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
Pm Palms	Severe: ponding.	Severe: seepage, ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, seepage.	Poor: ponding, excess humus.
PrA Parr	Moderate: percs slowly.	Moderate: seepage.	Slight	Slight	Good.
Pt Pewamo	Severe: percs slowly, ponding.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, ponding, hard to pack.
Pv*. Pits					
PxB Plainfield	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
PxC Plainfield	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
PzA Plainfield	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
RaB Rawson	Severe: percs slowly, wetness.	Severe: wetness.	Severe: too clayey.	Moderate: wetness.	Poor: too clayey.
Rb Rensselaer	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too sandy.	Severe: ponding.	Poor: too sandy, ponding.
Se Sebewa	Severe: ponding.	Severe: ponding, seepage.	Severe: ponding, seepage.	Severe: ponding, seepage.	Poor: small stones, seepage, too sandy.

See footnote at end of table.

TABLE 13.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
ShA, ShB: Shipshe	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
ShC: Shipshe	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Ud*. Udorthents					
Wa: Wallkill	Severe: ponding.	Severe: ponding, seepage, excess humus.	Severe: ponding, excess humus, seepage.	Severe: ponding, seepage.	Poor: ponding, excess humus.
WeA: Wawasee	Slight	Moderate: seepage.	Slight	Slight	Good.
WeB: Wawasee	Slight	Moderate: seepage, slope.	Slight	Slight	Good.
WeC2: Wawasee	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
WeD2: Wawasee	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
WhC3: Wawasee	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
WhD3: Wawasee	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Wt: Whitaker	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: wetness.	Poor: wetness.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and "poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Ad, Am Adrian	Poor: wetness, low strength.	Probable	Improbable: too sandy.	Poor: wetness, excess humus.
BaA Blount	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
BoA, BoB, BoC Boyer	Good	Probable	Probable	Poor: small stones, area reclaim.
BoD Boyer	Fair: slope.	Probable	Probable	Poor: small stones, area reclaim, slope.
Bp Brady	Fair: wetness.	Probable	Probable	Poor: small stones.
BtA Brems	Fair: wetness.	Probable	Improbable: too sandy.	Poor: too sandy.
BxA Bronson	Fair: wetness.	Probable	Probable	Poor: small stones.
ChB, ChC Chelsea	Good	Probable	Improbable: too sandy.	Poor: too sandy.
CrA Conover	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, small stones.
Ed Edwards	Poor: wetness, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness, excess humus.
Gf Gilford	Poor: wetness.	Probable	Improbable: too sandy.	Poor: wetness.
Gr Granby	Poor: wetness.	Probable	Improbable: too sandy.	Poor: wetness.
HaA Haskins	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
HdA, HdB, HdC Hillsdale	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
Ho Homer	Fair: wetness.	Probable	Probable	Poor: small stones, area reclaim.
Ht, Hw Houghton	Poor: wetness, low strength.	Improbable: excess humus.	Improbable: excess humus.	Poor: wetness, excess humus.
Hx Houghton	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess humus, wetness.
MbB Martinsville	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Mc--------------------- Martisco	Poor: wetness, excess humus.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
MeB-------------------- Metea	Poor: thin layer.	Improbable: thin layer.	Improbable: too sandy.	Fair: too sandy.
MeC-------------------- Metea	Poor: thin layer.	Improbable: thin layer.	Improbable: too sandy.	Fair: too sandy, slope.
MoB2------------------- Morley	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
MoC2------------------- Morley	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer, slope.
NaA-------------------- Nappanee	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
OsA, OsB, OsC---------- Oshtemo	Good	Probable	Probable	Poor: small stones.
OsD, OsE--------------- Oshtemo	Fair: slope.	Probable	Probable	Poor: small stones, slope.
OuB*, OuC*:				
Oshtemo----------------	Good	Probable	Probable	Poor: small stones.
Hillsdale--------------	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
Chelsea----------------	Good	Probable	Improbable: too sandy.	Poor: too sandy.
Pm--------------------- Palms	Poor: wetness, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness, excess humus.
PrA-------------------- Parr	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Pt--------------------- Pewamo	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Pv*. Pits				
PxB, PxC, PzA---------- Plainfield	Good	Probable	Improbable: too sandy.	Poor: too sandy.
RaB-------------------- Rawson	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
Rb--------------------- Rensselaer	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Se--------------------- Sebewa	Poor: wetness.	Probable	Probable	Poor: wetness.

See footnote at end of table.

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
ShA, ShB, ShC: Shipshe	Good	Probable	Probable	Poor: small stones, area reclaim.
Ud*. Udorthents				
Wa: Wallkill	Poor: low strength, frost action, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
WeA, WeB: Wawasee	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
WeC2: Wawasee	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
WeD2: Wawasee	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
WhC3: Wawasee	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
WhD3: Wawasee	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Wt: Whitaker	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. Absence of an entry indicates that the soil was not evaluated]

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Terraces and diversions	Grassed waterways
Ad, Am. Adrian	Seepage	Seepage, ponding, excess humus.	Slow refill, cutbanks cave.	Ponding, frost action, subsides.	Ponding, soil blowing, too sandy.	Wetness.
BaA. Blount	Favorable	Wetness	Deep to water, slow refill.	Percs slowly, frost action.	Wetness, percs slowly, erodes easily.	Erodes easily, wetness, percs slowly.
BoA, BoB. Boyer	Seepage	Seepage, piping.	No water	Deep to water	Too sandy, soil blowing.	Droughty.
BoC, BoD. Boyer	Seepage, slope.	Seepage, piping.	No water	Deep to water	Slope, too sandy, soil blowing.	Slope, droughty.
Bp. Brady	Seepage	Piping, wetness.	Cutbanks cave	Frost action	Wetness, soil blowing.	Wetness.
BtA. Brems	Seepage	Seepage, piping.	Cutbanks cave	Cutbanks cave	Wetness, too sandy, soil blowing.	Droughty, rooting depth.
BxA. Bronson	Seepage	Seepage, piping.	Cutbanks cave	Frost action, cutbanks cave.	Wetness, too sandy, soil blowing.	Favorable.
ChB. Chelsea	Seepage	Piping, seepage.	No water	Deep to water	Too sandy, soil blowing.	Droughty.
ChC. Chelsea	Slope, seepage.	Piping, seepage.	No water	Deep to water	Slope, too sandy, soil blowing.	Slope, droughty.
CrA. Conover	Seepage	Piping, wetness.	Slow refill	Frost action	Erodes easily, wetness.	Wetness, erodes easily, rooting depth.
Ed. Edwards	Seepage	Ponding	Slow refill	Frost action, ponding, subsides.	Ponding, soil blowing.	Wetness.
Gf. Gilford	Seepage	Seepage, piping, ponding.	Cutbanks cave	Ponding, frost action, cutbanks cave.	Ponding, too sandy, soil blowing.	Wetness, rooting depth.
Gr. Granby	Seepage	Seepage, piping, ponding.	Cutbanks cave	Ponding, cutbanks cave.	Ponding, too sandy, soil blowing.	Wetness, droughty, rooting depth.
HaA. Haskins	Favorable	Wetness	Slow refill	Frost action, percs slowly.	Wetness, percs slowly.	Wetness, percs slowly, erodes easily.
HdA, HdB. Hillsdale	Seepage	Piping	No water	Deep to water	Soil blowing	Rooting depth.
HdC. Hillsdale	Seepage, slope.	Piping	No water	Deep to water	Slope, soil blowing.	Slope, rooting depth.
Ho. Homer	Seepage	Seepage, wetness.	Cutbanks cave	Frost action, cutbanks cave.	Erodes easily, wetness, too sandy.	Wetness, erodes easily.
Ht, Hw. Houghton	Seepage	Excess humus, ponding.	Slow refill	Frost action, subsides, ponding.	Ponding, soil blowing.	Wetness.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Terraces and diversions	Grassed waterways
Hx: Houghton	Seepage	Excess humus, ponding.	Slow refill	Ponding, subsides, frost action.	Ponding	Wetness.
MbB: Martinsville	Seepage, slope.	Thin layer	No water	Deep to water	Erodes easily, soil blowing.	Erodes easily.
Mc: Martisco	Favorable	Ponding	Slow refill	Percs slowly, frost action, ponding.	Ponding	Wetness.
MeB: Metea	Seepage	Seepage, piping.	No water	Deep to water	Too sandy, soil blowing.	Droughty.
MeC: Metea	Seepage, slope.	Seepage, piping.	No water	Deep to water	Slope, too sandy, soil blowing.	Slope, droughty.
MoB2: Morley	Favorable	Favorable	Deep to water, slow refill.	Deep to water	Erodes easily, percs slowly.	Erodes easily, percs slowly.
MoC2: Morley	Favorable	Favorable	Deep to water, slow refill.	Deep to water	Erodes easily, percs slowly, slope.	Slope, erodes easily, percs slowly.
NaA: Nappanee	Favorable	Wetness	Slow refill	Percs slowly	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, rooting depth.
OsA, OsB: Oshtemo	Seepage	Seepage, piping.	No water	Deep to water	Too sandy, soil blowing.	Favorable.
OsC, OsD, OsE: Oshtemo	Seepage, slope.	Seepage, piping.	No water	Deep to water	Slope, too sandy, soil blowing.	Slope.
OuB*:						
Oshtemo	Seepage	Seepage, piping.	No water	Deep to water	Too sandy, soil blowing.	Favorable.
Hillsdale	Seepage	Piping	No water	Deep to water	Soil blowing	Rooting depth.
Chelsea	Seepage	Piping, seepage.	No water	Deep to water	Too sandy, soil blowing.	Droughty.
OuC*:						
Oshtemo	Seepage, slope.	Seepage, piping.	No water	Deep to water	Slope, too sandy, soil blowing.	Slope.
Hillsdale	Seepage, slope.	Piping	No water	Deep to water	Slope, soil blowing.	Slope, rooting depth.
Chelsea	Slope, seepage.	Piping, seepage.	No water	Deep to water	Slope, too sandy, soil blowing.	Slope, droughty.
Pm: Palms	Seepage	Excess humus, ponding.	Slow refill	Ponding, frost action, subsides.	Ponding, soil blowing.	Wetness.
PrA: Parr	Seepage	Piping	No water	Deep to water	Favorable	Favorable.
Pt: Pewamo	Favorable	Ponding	Slow refill	Ponding, frost action.	Ponding	Wetness.
Pv*. Pits						

See footnote at end of table.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Terraces and diversions	Grassed waterways
PxB---------------- Plainfield	Seepage--------	Seepage, piping.	No water-------	Deep to water	Too sandy, soil blowing.	Droughty.
PxC---------------- Plainfield	Seepage, slope.	Seepage, piping.	No water-------	Deep to water	Slope, too sandy, soil blowing.	Droughty, slope.
PzA---------------- Plainfield	Seepage--------	Seepage, piping.	No water-------	Deep to water	Too sandy, soil blowing.	Droughty.
RaB---------------- Rawson	Slope, seepage.	Hard to pack, wetness.	Deep to water, slow refill.	Percs slowly, slope.	Wetness, soil blowing.	Percs slowly.
Rb----------------- Rensselaer	Seepage--------	Piping, ponding.	Slow refill, cutbanks cave.	Ponding, percs slowly, frost action.	Ponding, too sandy.	Wetness, percs slowly.
Se----------------- Sebewa	Seepage--------	Seepage, ponding.	Cutbanks cave	Frost action, ponding, cutbanks cave.	Ponding, too sandy.	Wetness.
ShA, ShB----------- Shipshe	Seepage--------	Seepage--------	No water-------	Deep to water	Too sandy, soil blowing.	Droughty, rooting depth.
ShC---------------- Shipshe	Seepage, slope.	Seepage--------	No water-------	Deep to water	Slope, too sandy, soil blowing.	Slope, droughty, rooting depth.
Ud*. Udorthents						
Wa----------------- Wallkill	Seepage--------	Piping, excess humus.	Favorable------	Ponding, subsides, frost action.	Ponding--------	Wetness.
WeA---------------- Wawasee	Seepage--------	Thin layer, piping.	No water-------	Deep to water	Soil blowing---	Favorable.
WeB---------------- Wawasee	Seepage, slope.	Thin layer, piping.	No water-------	Deep to water	Soil blowing---	Favorable.
WeC2, WeD2--------- Wawasee	Slope----------	Thin layer, piping.	No water-------	Deep to water	Slope, soil blowing.	Slope.
WhC3, WhD3--------- Wawasee	Slope----------	Thin layer, piping.	No water-------	Deep to water	Slope----------	Slope.
Wt----------------- Whitaker	Seepage--------	Wetness--------	Slow refill, cutbanks cave.	Frost action---	Erodes easily, wetness, soil blowing.	Wetness, erodes easily.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--ENGINEERING INDEX PROPERTIES

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
Ad, Am------------- Adrian	0-25	Sapric material	Pt	A-8	---	---	---	---	---	---	---
	25-60	Sand, loamy sand, fine sand.	SP, SM	A-2, A-3, A-1	0	80-100	60-100	35-75	0-30	---	NP
BaA--------------- Blount	0-12	Silt loam-------	ML, CL	A-6, A-4	0-5	95-100	95-100	90-100	80-95	25-40	3-15
	12-27	Silty clay loam, silty clay, clay loam.	CH, CL	A-7, A-6	0-5	95-100	90-100	90-100	80-95	35-60	15-35
	27-60	Silty clay loam, clay loam.	CL	A-6	0-10	90-100	90-100	80-100	70-90	25-40	10-25
BoA, BoB, BoC, BoD- Boyer	0-18	Loamy sand------	SM, SM-SC	A-2, A-1	0-5	95-100	65-95	45-75	15-30	<20	NP-6
	18-36	Sandy loam, loam, gravelly sandy loam.	SM, SC, SM-SC, SP-SM	A-2, A-4, A-6	0-5	80-100	65-95	55-85	10-45	10-35	NP-16
	36-60	Stratified sand to gravel.	SP, SP-SM, GP, GP-GM	A-1, A-3, A-2-4	0-10	40-100	35-100	30-70	0-10	---	NP
Bp---------------- Brady	0-9	Sandy loam------	SM, SM-SC	A-2, A-4	0-5	95-100	75-100	60-70	25-40	<25	NP-7
	9-42	Sandy loam, sandy clay loam, loamy sand.	SM, SC, SM-SC	A-2, A-4, A-6	0-5	95-100	75-95	60-80	25-45	15-35	NP-16
	42-53	Loamy sand, sandy loam.	SM	A-2	0-5	95-100	75-95	55-70	15-35	---	NP
	53-60	Stratified sand to gravel.	SP, SP-SM, GP, GP-GM	A-1, A-3, A-2-4	0-5	40-75	35-70	20-55	0-10	---	NP
BtA--------------- Brems	0-13	Sand-----------	SM, SP-SM	A-2-4, A-3	0	100	85-100	50-85	5-15	---	NP
	13-50	Sand, fine sand, loamy sand.	SM, SP-SM	A-3, A-2-4	0	100	80-100	50-85	5-25	---	NP
	50-60	Sand, fine sand, loamy sand.	SP-SM	A-3, A-2-4	0	100	80-100	50-85	5-10	---	NP
BxA--------------- Bronson	0-20	Sandy loam, loamy sand.	SM, SM-SC	A-2, A-4	0-5	95-100	90-100	65-75	20-40	<25	NP-5
	20-37	Sandy loam, sandy clay loam, gravelly sandy loam.	SM, SC, SM-SC	A-2, A-4, A-6	0-5	95-100	60-95	60-85	25-45	<30	NP-15
	37-62	Loamy sand, gravelly loamy sand, sandy loam.	SM, SP-SM	A-2	0-5	85-95	60-95	55-70	10-15	---	NP
	62-74	Sand and gravel	SP, GP, SP-SM, GP-GM	A-1, A-2, A-3	0-10	40-90	35-85	20-60	0-10	---	NP
ChB, ChC---------- Chelsea	0-10	Fine sand-------	SM, SP-SM	A-2-4	0	100	100	65-80	10-35	---	NP
	10-80	Fine sand, sand, loamy sand.	SP, SM, SP-SM	A-3, A-2-4	0	100	100	65-80	3-15	---	NP
CrA--------------- Conover	0-16	Loam, sandy loam	ML, CL, CL-ML	A-4	0-5	95-100	90-100	80-95	55-90	20-30	3-10
	16-32	Clay loam, silty clay loam.	CL	A-6	0-5	95-100	90-100	80-95	50-90	29-40	15-25
	32-60	Loam, silt loam, clay loam.	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	80-95	50-75	25-34	6-14
Ed---------------- Edwards	0-25	Sapric material	Pt	A-8	0	---	---	---	---	---	---
	25-60	Marl-----------	---	---	0	100	95-100	80-90	60-80	---	---

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
Gf----------------- Gilford	0-12	Sandy loam------	SC, SM-SC	A-4, A-2-4	0	95-100	90-100	60-70	30-40	20-30	4-10
	12-36	Sandy loam, sandy clay loam	SM, SC, SM-SC	A-2-4	0	90-100	90-100	55-70	20-35	15-30	NP-8
	36-80	Loamy sand, sand	SM, SP, SP-SM	A-3, A-1-B, A-2-4	0	90-100	85-100	18-60	3-20	---	NP
Gr----------------- Granby	0-11	Loamy fine sand	SM	A-2	0	100	100	50-75	15-30	---	NP
	11-60	Sand, fine sand, loamy sand.	SP, SP-SM, SM	A-3, A-2	0	100	95-100	50-75	0-20	---	NP
HaA---------------- Haskins	0-13	Loam------------	CL-ML, CL, SC, SM-SC	A-4, A-6	0	95-100	90-100	85-95	45-60	25-40	5-20
	13-35	Sandy clay loam, clay loam, gravelly sandy clay loam.	SC, CL	A-6, A-4	0	85-100	75-100	60-85	40-65	20-40	7-20
	35-60	Clay, silty clay, clay loam.	CH, CL	A-7, A-6	0	100	90-100	90-100	80-95	35-65	15-40
HdA, HdB, HdC------ Hillsdale	0-17	Sandy loam------	SM, SC, ML, CL	A-2-4, A-4	0-5	95-100	85-100	60-90	20-65	15-30	2-10
	17-50	Sandy loam------	SM, SM-SC, SC	A-2-4, A-4	0-5	95-100	85-100	60-85	15-50	15-30	2-10
	50-80	Sandy loam, loamy sand.	SM, SC, SM-SC	A-2-4, A-4	0-5	95-100	85-100	55-80	25-40	15-22	3-8
Ho----------------- Homer	0-8	Sandy loam------	SM-SC, SC	A-2-4, A-4	0	95-100	90-100	60-70	30-40	20-30	5-10
	8-16	Sandy clay loam, clay loam.	CL	A-6, A-7	0	90-100	90-100	90-100	70-95	30-50	15-30
	16-30	Gravelly clay loam.	CL	A-6, A-7	0-5	90-95	75-85	75-85	60-75	30-45	15-25
	30-60	Stratified sand to very gravelly sand.	SP, GP, SP-SM, GP-GM	A-1	1-5	30-70	22-55	7-20	2-10	---	NP
Ht, Hw, Hx--------- Houghton	0-60	Sapric material	Pt	A-8	0	---	---	---	---	---	---
MbB---------------- Martinsville	0-18	Sandy loam, loam	SM, SC, SM-SC	A-4	0	100	90-100	65-80	35-45	<25	2-10
	18-31	Clay loam, silty clay loam, sandy clay loam.	CL, SC	A-4, A-6	0	100	90-100	65-90	40-90	20-35	8-20
	31-58	Sandy loam, sandy clay loam, loam.	SM, ML	A-2-4, A-4	0	100	90-100	60-80	30-60	30-40	2-8
	58-74	Stratified sand to sandy clay loam.	CL, SC, CL-ML, SM-SC	A-4	0	95-100	85-100	80-95	40-60	<25	4-9
Mc----------------- Martisco	0-10	Sapric material	Pt	---	0	---	---	---	---	---	---
	10-60	Marl------------	---	---	0	---	---	---	---	---	---
MeB, MeC----------- Metea	0-25	Loamy sand------	SM	A-2-4	0	100	100	50-80	15-35	---	NP
	25-58	Clay loam, sandy loam, silty clay loam.	CL, SC	A-6, A-7	0	90-100	90-95	75-95	40-75	25-50	12-30
	58-72	Loam, silty clay loam, clay loam.	CL, CL-ML	A-4, A-6	0-3	85-95	80-90	75-90	50-75	25-40	5-18

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
MoB2, MoC2--------- Morley	0-7	Loam------------	CL, CL-ML	A-6, A-4	0-5	95-100	95-100	90-100	85-95	25-40	5-15
	7-11	Silty clay loam, clay loam.	CL	A-6	0-10	95-100	90-100	85-95	80-90	25-40	10-20
	11-26	Silty clay, clay loam, clay.	CL, CH	A-6, A-7	0-10	95-100	90-100	85-95	80-90	30-55	15-30
	26-60	Silty clay loam, clay loam.	CL	A-6, A-7	0-10	95-100	90-100	85-95	80-90	30-45	10-25
NaA---------------- Nappanee	0-11	Silt loam--------	ML, CL	A-4, A-6	0-5	95-100	95-100	85-100	55-90	25-40	3-15
	11-32	Silty clay, clay	CL, CH	A-6, A-7	0-5	95-100	95-100	85-100	70-95	25-70	10-42
	32-60	Silty clay, clay, clay loam.	CL, CH	A-6, A-7	0-5	95-100	95-100	85-100	70-95	25-60	10-34
OsA, OsB, OsC, OsD, OsE. Oshtemo	0-9	Loamy sand------	SM	A-2, A-1	0	95-100	60-95	40-70	15-30	---	NP
	9-53	Sandy loam, sandy clay loam.	SM, SC, SM-SC	A-2, A-4, A-6	0	95-100	60-95	60-85	25-45	12-30	2-16
	53-60	Stratified coarse sand to gravel.	SP-SM, GP, SP, GP-GM	A-1, A-2, A-3	0-5	40-90	35-85	20-60	0-10	---	NP
OuB*, OuC*: Oshtemo-----------	0-9	Loamy sand------	SM	A-2, A-1	0	95-100	60-95	40-70	15-30	---	NP
	9-53	Sandy loam, gravelly sandy clay loam.	SM, SC, SM-SC	A-2, A-4, A-6	0	95-100	60-95	60-85	25-45	12-30	2-16
	53-60	Stratified coarse sand to gravel.	SP-SM, GP, SP, GP-GM	A-1, A-2, A-3	0-5	40-90	35-85	20-60	0-10	---	NP
Hillsdale---------	0-13	Sandy loam------	SM, SC, ML, CL	A-2-4, A-4	0-5	95-100	85-100	60-90	20-65	15-30	2-10
	13-70	Sandy loam------	SM, SM-SC, SC	A-2-4, A-4	0-5	95-100	85-100	60-85	15-50	15-30	2-10
	70-80	Sandy loam, loamy sand.	SM, SC, SM-SC	A-2-4, A-4	0-5	95-100	85-100	55-80	25-40	15-22	3-8
Chelsea-----------	0-10	Sand------------	SM, SP-SM	A-2-4	0	100	100	65-80	10-35	---	NP
	10-70	Fine sand, sand, loamy sand.	SP, SM, SP-SM	A-3, A-2-4	0	100	100	65-80	3-15	---	NP
Pm---------------- Palms	0-26	Sapric material	Pt	---	---	---	---	---	---	---	---
	26-60	Silt loam, silty clay loam, fine sandy loam.	CL-ML, CL	A-4, A-6	0	85-100	80-100	70-95	50-90	25-40	5-20
PrA--------------- Parr	0-19	Loam------------	CL, CL-ML	A-4, A-6	0	100	95-100	80-100	50-90	22-34	6-15
	19-33	Clay loam, loam	CL	A-6, A-7	0	90-100	90-95	80-90	65-75	35-50	17-31
	33-60	Loam------------	CL, ML, CL-ML	A-4, A-6	0-3	85-95	80-90	75-85	50-65	17-30	2-14
Pt---------------- Pewamo	0-12	Silty clay loam	CL	A-6	0-5	95-100	90-100	90-100	70-90	25-40	10-20
	12-44	Clay loam, clay, silty clay.	CL, CH	A-6, A-7	0-5	95-100	90-100	90-100	75-95	35-55	15-30
	44-60	Clay loam, silty clay loam.	CL	A-6, A-7	0-5	95-100	90-100	90-100	70-90	30-45	14-25
Pv*. Pits											
PxB, PxC, PzA------ Plainfield	0-9	Sand------------	SP-SM, SM, SP	A-3, A-2, A-1	0	75-100	75-100	40-80	3-35	---	NP
	9-60	Sand------------	SP	A-3, A-1, A-2	0	75-100	75-100	40-70	1-4	---	NP

See footnote at end of table.

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
RaB----------------- Rawson	0-18	Sandy loam, loam	SM, ML	A-2-4, A-4	0	95-100	90-100	60-85	30-55	---	NP
	18-39	Clay loam, sandy clay loam, gravelly sandy clay loam.	SC, CL	A-4, A-6	0	85-100	75-100	60-85	35-65	20-40	7-20
	39-60	Clay, silty clay, silty clay loam.	CH, CL	A-7, A-6	0	100	90-100	90-100	80-95	35-65	15-40
Rb----------------- Rensselaer	0-11	Loam, silty clay loam.	CL, ML	A-4, A-6	0	100	100	90-100	70-90	27-36	4-12
	11-35	Clay loam, silty clay loam.	CL	A-6, A-7	0	95-100	90-100	80-100	60-80	33-47	15-26
	35-60	Stratified fine sand to clay loam.	CL, SC, CL-ML, SM-SC	A-4, A-2	0	95-100	90-100	60-95	20-70	<30	4-9
Se----------------- Sebewa	0-11	Loam------------	CL, CL-ML	A-4, A-6	0	95-100	80-100	75-95	50-90	22-35	6-12
	11-33	Sandy clay loam, loam, gravelly clay loam.	SC, CL	A-4, A-6	0	95-100	65-95	55-85	40-75	25-40	8-20
	33-60	Sand and gravel	SP, SP-SM, GP, GP-GM	A-1	0-5	40-75	35-70	20-40	0-10	---	NP
ShA, ShB, ShC------ Shipshe	0-12	Sandy loam------	SC, SM-SC, SM	A-2-4, A-2-6, A-4, A-6	0-2	90-100	75-100	45-70	20-40	<25	NP-12
	12-32	Very gravelly sandy loam, very gravelly sandy clay loam, gravelly clay loam.	GC, GW-GM, SW-SM, SC	A-2, A-1, A-4, A-6	0-2	30-60	25-50	15-50	5-40	<25	NP-12
	32-60	Stratified sandy loam to very gravelly sand.	SW, SW-SM, GW, GW-GM	A-1	1-5	30-70	20-55	5-20	2-10	---	NP
Ud*. Udorthents											
Wa----------------- Wallkill	0-9	Silt loam-------	ML, SM, OL	A-5, A-7	0	95-100	90-100	70-100	40-90	40-50	5-15
	9-21	Silt loam, loam, gravelly silt loam.	CL, CL-ML, SM-SC, SC	A-4	0	75-100	70-100	60-100	40-90	15-25	5-10
	21-60	Sapric material, hemic material.	Pt	A-8	0	---	---	---	---	---	---
WeA, WeB, WeC2, WeD2. Wawasee	0-4	Fine sandy loam	SM, SM-SC	A-2-4, A-4	0	90-95	85-95	80-95	30-50	<25	NP-6
	4-28	Loam, sandy clay loam.	CL, SC	A-4, A-6	0	90-95	85-95	80-95	45-70	25-35	7-15
	28-60	Loam, sandy loam	SM-SC, SC, CL-ML, CL	A-4, A-6, A-2	0	75-95	70-95	50-90	25-66	20-30	4-12
WhC3, WhD3--------- Wawasee	0-8	Loam------------	CL, CL-ML	A-4, A-6	0	90-95	85-95	80-95	50-70	20-30	4-12
	8-38	Loam, sandy clay loam.	CL, SC	A-4, A-6	0	90-95	85-95	80-95	45-70	25-35	7-15
	38-60	Loam, sandy loam	SM-SC, SC, CL-ML, CL	A-4, A-6, A-2	0	75-95	70-95	50-90	25-66	20-30	4-12

See footnote at end of table.

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Wt------------------ Whitaker	0-14	Sandy loam------	SM, SC, SM-SC	A-4	0	100	95-100	65-80	35-45	15-25	2-10
	14-38	Clay loam, loam, sandy clay loam.	CL	A-6, A-7	0	100	95-100	90-100	70-80	30-47	12-26
	38-60	Stratified coarse sand to clay.	CL, SC, ML, SM	A-4	0	98-100	98-100	60-85	40-60	15-25	3-9

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group
						K	T	
	In	In/hr	In/in	pH				
Ad, Am------------	0-25	0.2-6.0	0.35-0.45	5.1-7.8	--------------	----	---	3
Adrian	25-60	6.0-20	0.03-0.08	5.6-8.4	Low-----------	----		
BaA---------------	0-12	0.6-2.0	0.20-0.24	5.1-6.5	Low-----------	0.43	3	6
Blount	12-27	0.06-0.2	0.06-0.10	4.5-6.5	Moderate------	0.43		
	27-60	0.06-0.2	0.07-0.10	7.4-8.4	Moderate------	0.43		
BoA, BoB, BoC,	0-18	6.0-20	0.10-0.12	5.6-7.3	Low-----------	0.17	4	2
BoD.	18-36	2.0-6.0	0.12-0.18	5.6-7.8	Low-----------	0.24		
Boyer	36-60	>20	0.02-0.04	7.4-8.4	Low-----------	0.10		
Bp----------------	0-9	2.0-6.0	0.12-0.15	5.6-7.3	Low-----------	0.20	5	3
Brady	9-42	2.0-6.0	0.12-0.17	5.1-6.5	Low-----------	0.20		
	42-53	2.0-20	0.08-0.10	5.1-6.5	Low-----------	0.20		
	53-60	>20	0.02-0.04	6.6-8.4	Low-----------	0.10		
BtA---------------	0-13	6.0-20	0.07-0.09	5.1-6.5	Low-----------	0.17	5	1
Brems	13-50	6.0-20	0.05-0.08	4.5-6.0	Low-----------	0.17		
	50-60	6.0-20	0.05-0.07	5.1-6.5	Low-----------	0.17		
BxA---------------	0-20	2.0-6.0	0.13-0.15	5.1-6.0	Low-----------	0.24	4	3
Bronson	20-37	2.0-6.0	0.12-0.18	5.1-6.0	Low-----------	0.24		
	37-62	6.0-20	0.06-0.08	5.1-7.3	Low-----------	0.17		
	62-74	>20	0.02-0.04	7.4-8.4	Low-----------	0.10		
ChB, ChC----------	0-10	6.0-20	0.10-0.15	5.6-7.3	Low-----------	0.17	5	2
Chelsea	10-80	6.0-20	0.06-0.08	5.1-5.5	Low-----------	0.17		
CrA---------------	0-16	0.6-2.0	0.18-0.24	5.6-6.5	Low-----------	0.28	5	5
Conover	16-32	0.2-0.6	0.15-0.18	5.6-7.3	Moderate------	0.28		
	32-60	0.2-0.6	0.05-0.19	7.4-8.4	Low-----------	0.37		
Ed----------------	0-25	0.2-6.0	0.35-0.45	5.6-7.8	--------------	----	---	3
Edwards	25-60	---	---	7.4-8.4	--------------	----		
Gf----------------	0-12	2.0-6.0	0.13-0.15	6.1-7.3	Low-----------	0.20	4	3
Gilford	12-36	2.0-6.0	0.12-0.14	6.1-7.3	Low-----------	0.20		
	36-80	6.0-20	0.05-0.08	6.6-8.4	Low-----------	0.15		
Gr----------------	0-11	6.0-20	0.10-0.12	5.6-7.3	Low-----------	0.17	5	2
Granby	11-60	6.0-20	0.05-0.12	5.6-7.8	Low-----------	0.17		
HaA---------------	0-13	0.6-2.0	0.16-0.18	5.1-7.3	Low-----------	0.37	4	5
Haskins	13-35	0.6-2.0	0.12-0.16	5.1-7.3	Low-----------	0.37		
	35-60	<0.2	0.08-0.14	6.6-8.4	High----------	0.37		
HdA, HdB, HdC-----	0-17	0.6-6.0	0.13-0.22	5.1-7.3	Low-----------	0.24	5	3
Hillsdale	17-50	0.6-2.0	0.13-0.15	4.5-6.5	Low-----------	0.24		
	50-80	2.0-6.0	0.11-0.13	7.9-8.4	Low-----------	0.24		
Ho----------------	0-8	0.6-2.0	0.13-0.15	5.1-7.3	Low-----------	0.24	4	3
Homer	8-16	0.6-2.0	0.17-0.19	5.1-6.0	Moderate------	0.37		
	16-30	0.6-2.0	0.09-0.12	6.1-8.4	Low-----------	0.24		
	30-60	>20	0.02-0.04	7.9-8.4	Low-----------	0.10		
Ht, Hw------------	0-60	0.2-6.0	0.35-0.45	5.6-7.8	--------------	----	---	3
Houghton								
Hx----------------	0-60	0.2-6.0	0.35-0.45	6.6-7.3	--------------	----	---	8
Houghton								

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	In/hr	In/in	pH				
MbB------------- Martinsville	0-18	0.6-2.0	0.16-0.18	5.6-7.3	Low-----------	0.24	5	3
	18-31	0.6-2.0	0.17-0.20	5.1-6.0	Moderate------	0.37		
	31-58	0.6-2.0	0.12-0.14	5.6-6.5	Low-----------	0.24		
	58-74	0.6-2.0	0.19-0.21	7.4-8.4	Low-----------	0.24		
Mc-------------- Martisco	0-10	0.2-6.0	0.25-0.35	6.1-8.4	Low-----------	----	---	---
	10-60	0.06-0.2	---	7.9-8.4	Low-----------	----		
MeB, MeC--------- Metea	0-25	>20	0.10-0.12	5.6-7.3	Low-----------	0.17	5	2
	25-58	0.6-2.0	0.15-0.19	5.6-7.3	Moderate------	0.32		
	58-72	0.6-2.0	0.05-0.19	7.4-8.4	Low-----------	0.32		
MoB2, MoC2------- Morley	0-7	0.6-2.0	0.20-0.24	5.1-6.5	Low-----------	0.43	3	6
	7-11	0.2-0.6	0.18-0.20	5.1-6.5	Moderate------	0.43		
	11-26	0.06-0.2	0.11-0.13	5.6-6.5	Moderate------	0.43		
	26-60	0.2-0.6	0.09-0.20	6.6-8.4	Moderate------	0.43		
NaA-------------- Nappanee	0-11	0.6-2.0	0.20-0.24	5.1-7.3	Low-----------	0.43	3	6
	11-32	<0.06	0.10-0.14	5.1-7.8	High----------	0.32		
	32-60	<0.06	0.08-0.12	7.4-8.4	High----------	0.32		
OsA, OsB, OsC, OsD, OsE. Oshtemo	0-9	6.0-20	0.10-0.12	5.1-6.5	Low-----------	0.24	5	2
	9-53	2.0-6.0	0.12-0.19	5.1-6.5	Low-----------	0.24		
	53-60	>20	0.02-0.04	7.4-8.4	Low-----------	0.10		
OuB*, OuC*:								
Oshtemo---------	0-9	6.0-20	0.10-0.12	5.1-6.5	Low-----------	0.24	5	2
	9-53	2.0-6.0	0.12-0.19	5.1-6.5	Low-----------	0.24		
	53-60	>20	0.02-0.04	7.4-8.4	Low-----------	0.10		
Hillsdale-------	0-13	0.6-6.0	0.13-0.22	5.1-7.3	Low-----------	0.24	5	3
	13-70	0.6-2.0	0.13-0.15	4.5-6.5	Low-----------	0.24		
	70-80	2.0-6.0	0.11-0.13	7.9-8.4	Low-----------	0.24		
Chelsea---------	0-10	6.0-20	0.10-0.15	5.6-7.3	Low-----------	0.17	5	2
	10-70	6.0-20	0.06-0.08	5.1-5.5	Low-----------	0.17		
Pm--------------- Palms	0-26	0.2-6.0	0.35-0.45	5.1-8.4	--------------	----	---	3
	26-60	0.2-2.0	0.14-0.22	6.1-8.4	Low-----------	----		
PrA-------------- Parr	0-19	0.6-2.0	0.21-0.24	5.6-7.3	Low-----------	0.32	5	5
	19-33	0.6-2.0	0.15-0.19	5.6-6.5	Moderate------	0.32		
	33-60	0.6-2.0	0.05-0.19	7.4-8.4	Low-----------	0.32		
Pt--------------- Pewamo	0-12	0.6-2.0	0.17-0.22	6.1-7.3	Moderate------	0.24	5	6
	12-44	0.2-0.6	0.12-0.20	6.1-7.8	Moderate------	0.24		
	44-60	0.2-0.6	0.14-0.18	7.4-8.4	Moderate------	0.24		
Pv*. Pits								
PxB, PxC, PzA---- Plainfield	0-9	6.0-20	0.04-0.09	4.5-7.3	Low-----------	0.17	5	1
	9-60	6.0-20	0.04-0.07	4.5-6.0	Low-----------	0.17		
RaB-------------- Rawson	0-18	0.6-2.0	0.13-0.18	4.5-7.3	Low-----------	0.24	4-3	3
	18-39	0.6-2.0	0.12-0.16	5.6-7.8	Low-----------	0.32		
	39-60	<0.2	0.08-0.14	7.4-7.8	High----------	0.32		
Rb--------------- Rensselaer	0-11	0.2-0.6	0.20-0.24	6.6-7.3	Low-----------	0.28	5	5
	11-35	0.06-0.2	0.15-0.19	6.1-7.3	Moderate------	0.28		
	35-60	0.6-2.0	0.19-0.21	7.9-8.4	Low-----------	0.28		
Se--------------- Sebewa	0-11	0.6-2.0	0.18-0.22	6.1-7.8	Low-----------	0.24	4	5
	11-33	0.6-2.0	0.15-0.19	6.1-7.8	Low-----------	0.24		
	33-60	6.0-20	0.02-0.04	7.4-8.4	Low-----------	0.10		

See footnote at end of table.

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group
						K	T	
	In	In/hr	In/in	pH				
ShA, ShB, ShC---- Shipshe	0-12	2.0-6.0	0.13-0.15	5.6-7.3	Low-----------	0.20	3	3
	12-32	2.0-6.0	0.05-0.07	5.6-6.5	Low-----------	0.10		
	32-60	>20	0.02-0.04	7.9-8.4	Low-----------	0.10		
Ud*. Udorthents								
Wa--------------- Wallkill	0-9	0.6-2.0	0.16-0.21	5.1-7.3	Low-----------	0.49	3	---
	9-21	0.6-2.0	0.15-0.20	5.1-7.3	Low-----------	0.43		
	21-60	0.2-6.0	0.19-0.22	5.6-7.3	Low-----------	----		
WeA, WeB, WeC2, WeD2. Wawasee	0-4	0.6-2.0	0.13-0.15	6.1-7.3	Low-----------	0.28	5	3
	4-28	0.6-2.0	0.12-0.18	6.1-7.3	Low-----------	0.28		
	28-60	0.6-2.0	0.11-0.18	6.6-8.4	Low-----------	0.28		
WhC3, WhD3------- Wawasee	0-8	0.6-2.0	0.16-0.20	6.1-7.3	Low-----------	0.28	4	5
	8-38	0.6-2.0	0.12-0.18	6.1-7.3	Low-----------	0.28		
	38-60	0.6-2.0	0.11-0.18	6.6-8.4	Low-----------	0.28		
Wt--------------- Whitaker	0-14	0.6-2.0	0.16-0.18	5.6-7.3	Low-----------	0.24	5	3
	14-38	0.6-2.0	0.15-0.19	5.1-6.0	Moderate------	0.37		
	38-60	0.6-6.0	0.19-0.21	6.6-8.4	Low-----------	0.37		

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 18.--SOIL AND WATER FEATURES

[The definitions of "flooding" and "water table" in the text explain terms such as "rare," "brief," "apparent," and "perched." The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern]

Soil name and map symbol	Hydrologic group	Flooding			High water table*			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
Ad, Am------------ Adrian	A/D	None--------	---	---	+.5-1.0	Apparent	Nov-May	>60	---	High-----	High-----	Moderate.
BaA--------------- Blount	C	None--------	---	---	1.0-3.0	Perched	Jan-May	>60	---	High-----	High-----	High.
BoA, BoB, BoC, BoD. Boyer	B	None--------	---	---	>6.0	---	---	>60	---	Low------	Low------	Moderate.
Bp---------------- Brady	B	None--------	---	---	1.0-3.0	Apparent	Nov-May	>60	---	High-----	Low------	Moderate.
BtA--------------- Brems	A	None--------	---	---	2.0-3.0	Apparent	Jan-Apr	>60	---	Low------	Low------	High.
BxA--------------- Bronson	B	None--------	---	---	2.0-3.5	Apparent	Nov-May	>60	---	High-----	Low------	High.
ChB, ChC---------- Chelsea	A	None--------	---	---	>6.0	---	---	>60	---	Low------	Low------	Low.
CrA--------------- Conover	B	None--------	---	---	1.0-2.0	Apparent	Nov-May	>60	---	High-----	High-----	Moderate.
Ed---------------- Edwards	B/D	None--------	---	---	+.5-0.5	Apparent	Sep-Jun	>60	---	High-----	High-----	Low.
Gf---------------- Gilford	B/D	None--------	---	---	+.5-1.0	Apparent	Dec-May	>60	---	High-----	High-----	Moderate.
Gr---------------- Granby	A/D	None--------	---	---	+.5-1.0	Apparent	Nov-Jun	>60	---	Moderate	High-----	Low.
HaA--------------- Haskins	C	None--------	---	---	1.0-2.5	Perched	Jan-Apr	>60	---	High-----	High-----	Moderate.
HdA, HdB, HdC----- Hillsdale	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low------	High.
Ho---------------- Homer	B	None--------	---	---	1.0-3.0	Apparent	Jan-Apr	>60	---	High-----	High-----	High.
Ht, Hw------------ Houghton	A/D	None--------	---	---	+.5-1.0	Apparent	Sep-Jun	>60	---	High-----	High-----	Low.
Hx---------------- Houghton	D	None--------	---	---	+2-0.5	Apparent	Sep-Jun	>60	---	High-----	High-----	Low.
MbB--------------- Martinsville	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.

See footnotes at end of table.

TABLE 18.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table*			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
Mc----------------- Martisco	D	None---------	---	---	+.5-0.5	Apparent	Oct-Jun	>60	---	High-----	High-----	Low.
MeB, MeC---------- Metea	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
MoB2, MoC2-------- Morley	C	None---------	---	---	3.0-6.0	Perched	Mar-May	>60	---	Moderate	High-----	Moderate.
NaA--------------- Nappanee	D	None---------	---	---	1.0-2.0	Apparent	Nov-May	>60	---	Moderate	High-----	Low.
OsA, OsB, OsC, OsD, OsE. Oshtemo	B	None---------	---	---	>6.0	---	---	>60	---	Low------	Low------	High.
OuB**, OuC**:												
Oshtemo-----------	B	None---------	---	---	>6.0	---	---	>60	---	Low------	Low------	High.
Hillsdale---------	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Low------	High.
Chelsea-----------	A	None---------	---	---	>6.0	---	---	>60	---	Low------	Low------	Low.
Pm---------------- Palms	A/D	None---------	---	---	+.5-1.0	Apparent	Nov-May	>60	---	High-----	High-----	Moderate.
PrA--------------- Parr	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
Pt---------------- Pewamo	C/D	None---------	---	---	+.5-1.0	Apparent	Dec-May	>60	---	High-----	High-----	Low.
Pv**. Pits												
PxB, PxC, PzA----- Plainfield	A	None---------	---	---	>6.0	---	---	>60	---	Low------	Low------	High.
RaB--------------- Rawson	B	None---------	---	---	2.5-4.0	Perched	Jan-Apr	>60	---	Moderate	High-----	High.
Rb---------------- Rensselaer	B/D	None---------	---	---	+.5-1.0	Apparent	Dec-May	>60	---	High-----	High-----	Low.
Se---------------- Sebewa	B/D	None---------	---	---	+.5-1.0	Apparent	Sep-May	>60	---	High-----	High-----	Low.
ShA, ShB, ShC----- Shipshe	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Low------	Moderate.
Ud**. Udorthents												

See footnotes at end of table.

TABLE 18.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table*			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
Wa----------------- Wallkill	D	None---------	---	---	+.5-0.5	Apparent	Sep-Jun	>60	---	High-----	Moderate	Moderate.
WeA, WeB, WeC2, WeD2, WhC3, WhD3. Wawasee	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	High-----	Low.
Wt----------------- Whitaker	C	None---------	---	---	1.0-3.0	Apparent	Jan-Apr	>60	---	High-----	High-----	Moderate.

* A plus sign under "High water table--Depth" indicates ponding.

**See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 19.--CLASSIFICATION OF THE SOILS

[An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series]

Soil name	Family or higher taxonomic class
Adrian	Sandy or sandy-skeletal, mixed, euic, mesic Terric Medisaprists
Blount	Fine, illitic, mesic Aeric Ochraqualfs
Boyer	Coarse-loamy, mixed, mesic Typic Hapludalfs
Brady	Coarse-loamy, mixed, mesic Aquollic Hapludalfs
Brems	Mixed, mesic Aquic Udipsamments
Bronson	Coarse-loamy, mixed, mesic Aquic Hapludalfs
Chelsea	Mixed, mesic Alfic Udipsamments
Conover	Fine-loamy, mixed, mesic Udollic Ochraqualfs
Edwards	Marly, euic, mesic Limnic Medisaprists
Gilford	Coarse-loamy, mixed, mesic Typic Haplaquolls
Granby	Sandy, mixed, mesic Typic Haplaquolls
Haskins	Fine-loamy, mixed, mesic Aeric Ochraqualfs
Hillsdale	Coarse-loamy, mixed, mesic Typic Hapludalfs
Homer	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Aeric Ochraqualfs
Houghton	Euic, mesic Typic Medisaprists
Martinsville	Fine-loamy, mixed, mesic Typic Hapludalfs
Martisco	Fine-silty, carbonatic, mesic Histic Humaquepts
Metea	Loamy, mixed, mesic Arenic Hapludalfs
Morley	Fine, illitic, mesic Typic Hapludalfs
Nappanee	Fine, illitic, mesic Aeric Ochraqualfs
Oshtemo	Coarse-loamy, mixed, mesic Typic Hapludalfs
Palms	Loamy, mixed, euic, mesic Terric Medisaprists
Parr	Fine-loamy, mixed, mesic Typic Argiudolls
Pewamo	Fine, mixed, mesic Typic Argiaquolls
Plainfield	Mixed, mesic Typic Udipsamments
*Rawson	Fine-loamy, mixed, mesic Typic Hapludalfs
Rensselaer	Fine-loamy, mixed, mesic Typic Argiaquolls
Sebewa	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Argiaquolls
Shipshe	Loamy-skeletal, mixed, mesic Typic Argiudolls
Udorthents	Loamy, mixed, nonacid, mesic Udorthents
Wallkill	Fine-loamy, mixed, nonacid, mesic Thapto-Histic Fluvaquents
Wawasee	Fine-loamy, mixed, mesic Typic Hapludalfs
Whitaker	Fine-loamy, mixed, mesic Aeric Ochraqualfs

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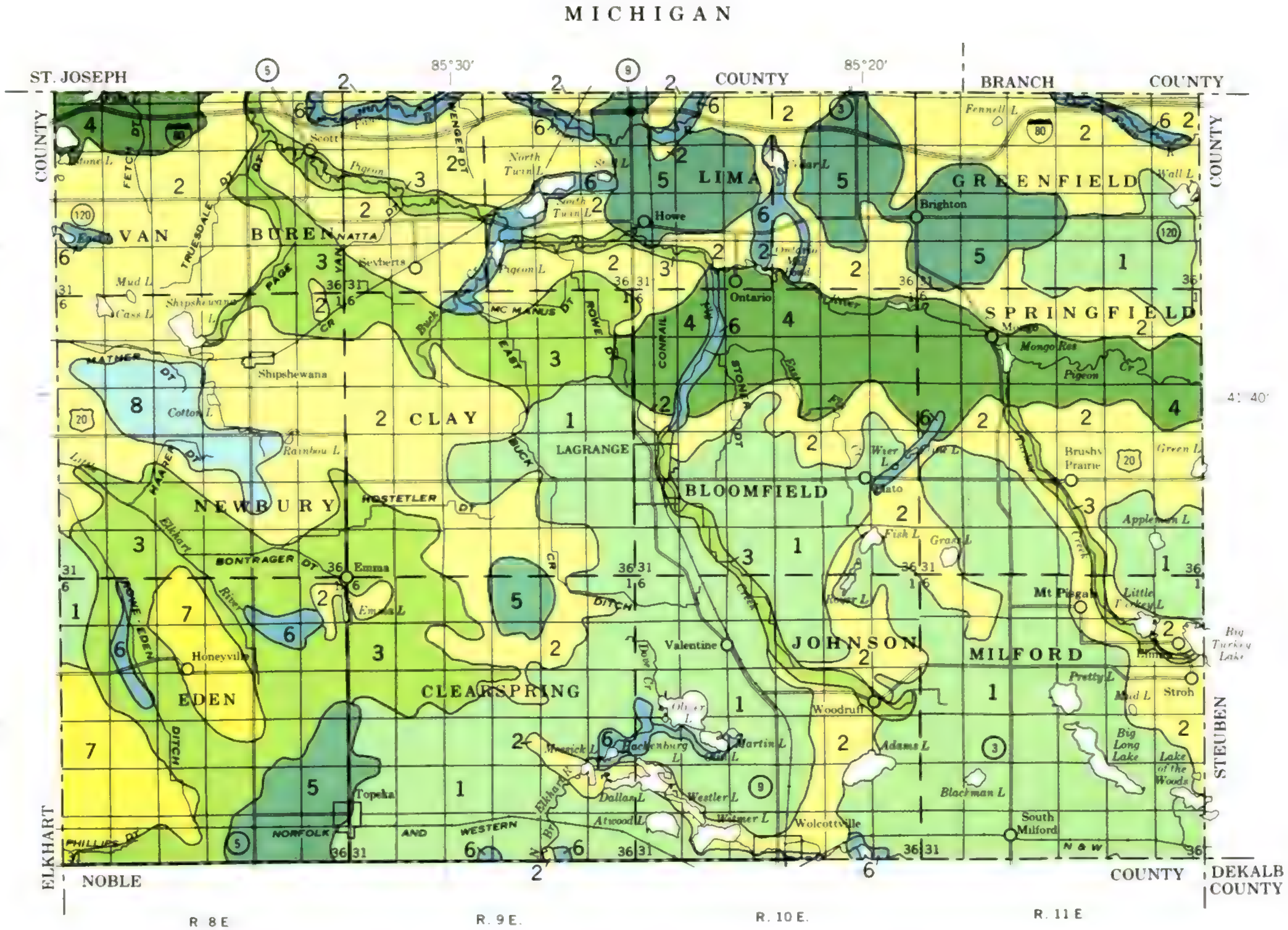
NRCS Accessibility Statement

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
PURDUE UNIVERSITY AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP

LAGRANGE COUNTY, INDIANA

Scale 1: 190,080



SOIL LEGEND*

1	Wawasee–Hillsdale–Conover: Nearly level to strongly sloping, well drained and somewhat poorly drained, moderately coarse textured and medium textured soils on till plains and moraines
2	Boyer–Oshtemo: Nearly level to moderately steep, well drained, coarse textured soils on outwash plains, valley trains, moraines, and kames
3	Sebewa–Gilford–Homer: Nearly level, very poorly drained and somewhat poorly drained, medium textured and moderately coarse textured soils on outwash plains and valley trains
4	Plainfield–Gilford: Nearly level to moderately sloping, excessively drained and very poorly drained, coarse textured and moderately coarse textured soils on outwash plains, knolls, and eolian dunes
5	Shipshe–Parr: Nearly level to moderately sloping, well drained, moderately coarse textured and medium textured soils on outwash plains and till plains
6	Houghton–Adrian: Nearly level, very poorly drained muck soils in depressional areas on outwash plains, till plains, and moraines
7	Blount–Pewamo: Nearly level and gently sloping, somewhat poorly drained and very poorly drained, medium textured and moderately fine textured soils on till plains
8	Rawson–Morley: Gently sloping to strongly sloping, well drained and moderately well drained, medium textured and moderately coarse textured soils on till plains and moraines

*The texture given in the descriptive heading refers to the texture of the surface layer of the major soils in each map unit.

Compiled 1979

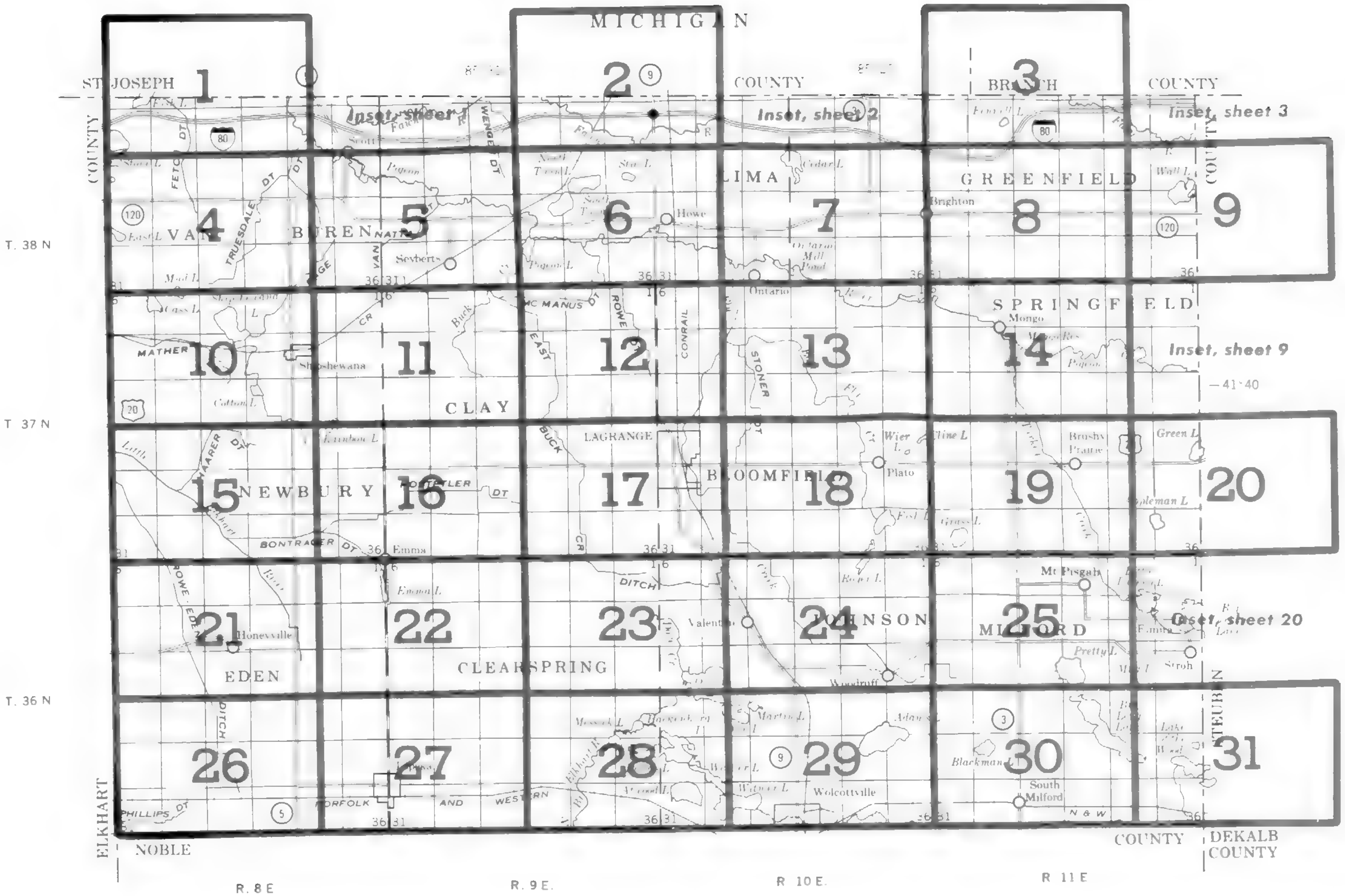
SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

INDEX TO MAP SHEETS
LAGRANGE COUNTY, INDIANA

Scale 1:190,080



Original text from each individual map sheet read:
This map is compiled on 1972 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

SOIL LEGEND

Map symbols consist of a combination of letters or of letters and numbers. The first capital letter is the initial one of the map unit name. The lowercase letter that follows separates map units having names that begin with the same letter, except that it does not separate sloping or eroded phases. The second capital letter indicates the class of slope. Symbols without a slope letter are for nearly level soils or miscellaneous areas. A final number of 2 indicates that the soil is eroded and 3 that it is severely eroded.

SYMBOL	NAME
Ad	Adrian muck
Am	Adrian muck, drained
BaA	Blount silt loam, 0 to 3 percent slopes
BoA	Boyer loamy sand, 0 to 2 percent slopes
BoB	Boyer loamy sand, 2 to 6 percent slopes
BoC	Boyer loamy sand, 6 to 12 percent slopes
BoD	Boyer loamy sand, 12 to 18 percent slopes
Bp	Brady sandy loam
BtA	Brems sand, 0 to 3 percent slopes
BxA	Bronson sandy loam, 0 to 3 percent slopes
ChB	Chelsea fine sand, 1 to 6 percent slopes
ChC	Chelsea fine sand, 6 to 12 percent slopes
CrA	Conover loam, 0 to 3 percent slopes
Ed	Edwards muck
Gf	Gilford sandy loam
Gr	Granby loamy fine sand
HaA	Haskins loam, 0 to 3 percent slopes
HdA	Hillsdale sandy loam, 0 to 2 percent slopes
HdB	Hillsdale sandy loam, 2 to 6 percent slopes
HdC	Hillsdale sandy loam, 6 to 12 percent slopes
Ho	Homer sandy loam
Ht	Houghton muck
Hw	Houghton muck, drained
Hx	Houghton muck, ponded
MbB	Martinsville sandy loam, 1 to 6 percent slopes
Mc	Martisco muck
MeB	Metea loamy sand, 2 to 6 percent slopes
MeC	Metea loamy sand, 6 to 12 percent slopes
MoB2	Morley loam, 2 to 6 percent slopes, eroded
MoC2	Morley loam, 6 to 14 percent slopes, eroded
NaA	Nappanee silt loam, 0 to 3 percent slopes
OsA	Oshtemo loamy sand, 0 to 2 percent slopes
OsB	Oshtemo loamy sand, 2 to 6 percent slopes
OsC	Oshtemo loamy sand, 6 to 12 percent slopes
OsD	Oshtemo loamy sand, 12 to 18 percent slopes
OsE	Oshtemo loamy sand, 18 to 25 percent slopes
OuB	Oshtemo–Hillsdale–Chelsea complex, 3 to 6 percent slopes
OuC	Oshtemo–Hillsdale–Chelsea complex, 6 to 12 percent slopes
Pm	Palms muck, drained
PrA	Parr loam, 0 to 2 percent slopes
Pt	Pewamo silty clay loam
Pv	Pits, gravel
PxB	Plainfield sand, 2 to 6 percent slopes
PxC	Plainfield sand, 6 to 12 percent slopes
PzA	Plainfield loamy sand, 0 to 2 percent slopes
RaB	Rawson sandy loam, 2 to 6 percent slopes
Rb	Rensselaer loam
Se	Sebewa loam
ShA	Shipshe sandy loam, 0 to 2 percent slopes
ShB	Shipshe sandy loam, 2 to 6 percent slopes
ShC	Shipshe sandy loam, 6 to 12 percent slopes
Ud	Udorthents, loamy
Wa	Wallkill silt loam
WeA	Wawasee fine sandy loam, 0 to 2 percent slopes
WeB	Wawasee fine sandy loam, 2 to 6 percent slopes
WeC2	Wawasee fine sandy loam, 6 to 12 percent slopes, eroded
WeD2	Wawasee fine sandy loam, 12 to 18 percent slopes, eroded
WhC3	Wawasee loam, 6 to 12 percent slopes, severely eroded
WhD3	Wawasee loam, 12 to 18 percent slopes, severely eroded
Wt	Whitaker sandy loam

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- National, state or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline & neatline

AD HOC BOUNDARY (label)

- Small airport, airfield, park, oilfield, cemetery, or flood pool

STATE COORDINATE TICK

LAND DIVISION CORNERS (sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEMS & DESIGNATIONS

- Interstate
- Federal
- State
- County, farm or ranch

RAILROAD

POWER TRANSMISSION LINE (normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or small

PITS

- Gravel pit
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School
- Indian mound (label)
- Located object (label)
- Tank (label)
- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
  - Double-line (label)
  - Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial
- Intermittent

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS

ESCARPMENTS

- Bedrock (points down slope)
- Other than bedrock (points down slope)

SHORT STEEP SLOPE

GULLY

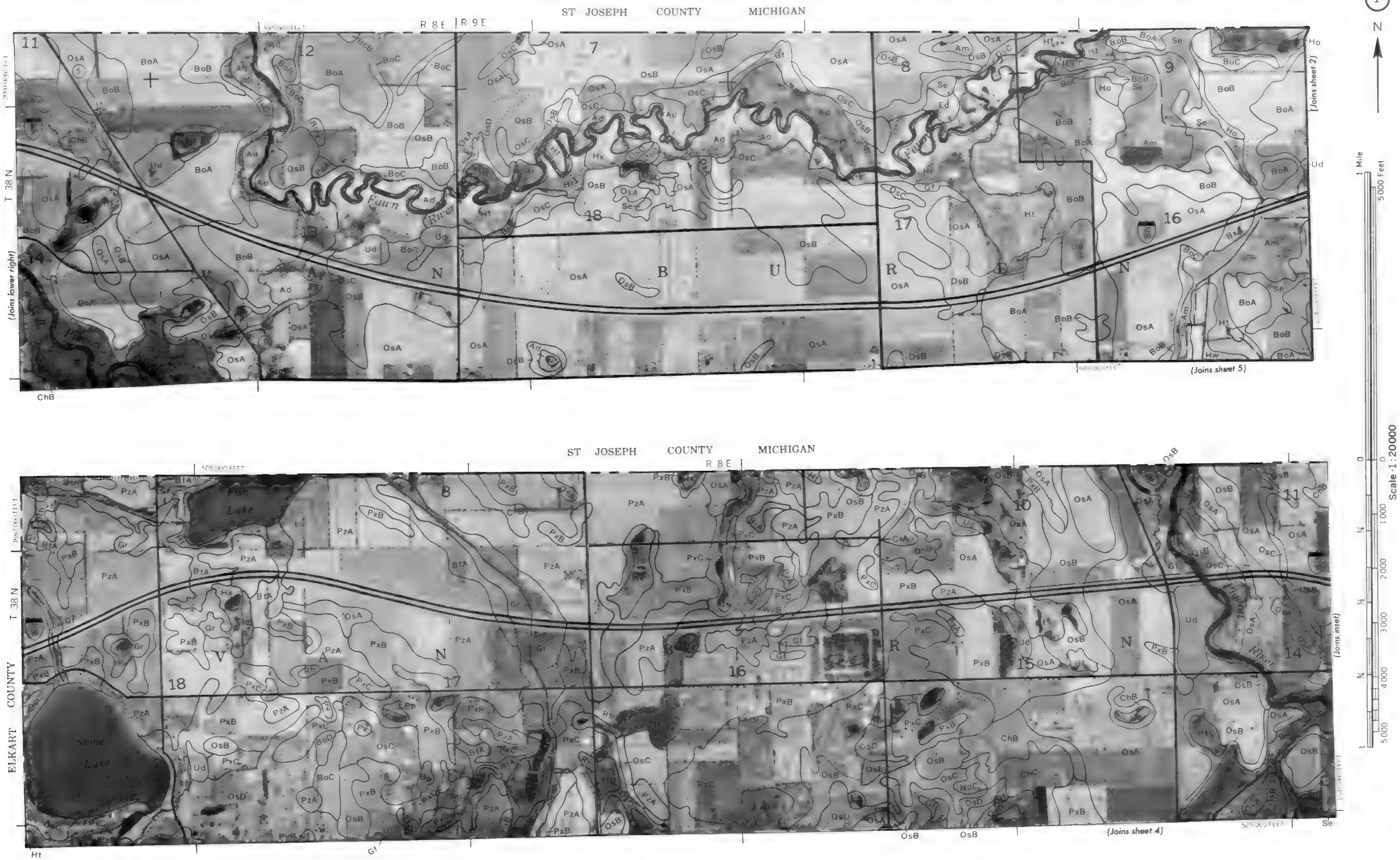
DEPRESSION OR SINK

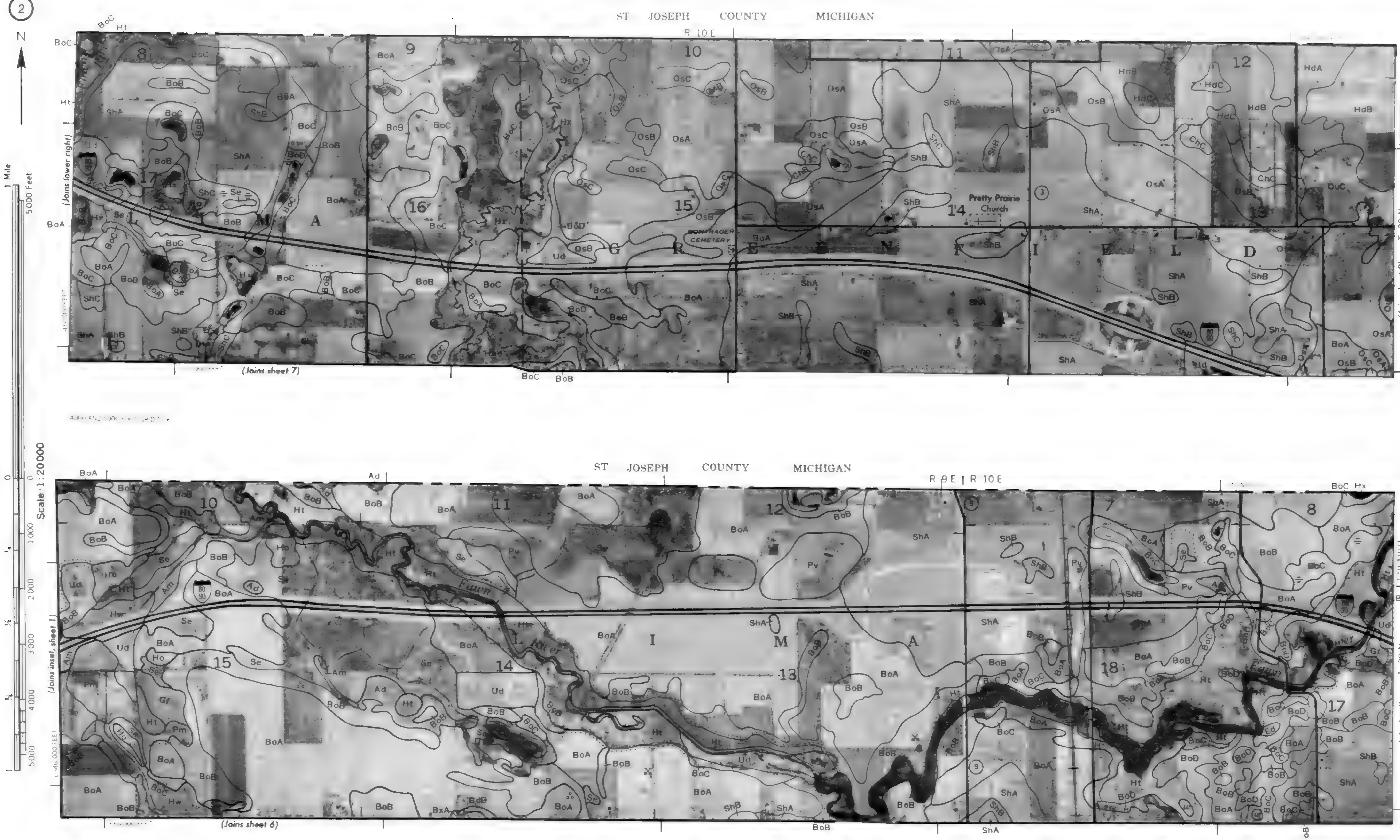
SOIL SAMPLE SITE (normally not shown)

MISCELLANEOUS

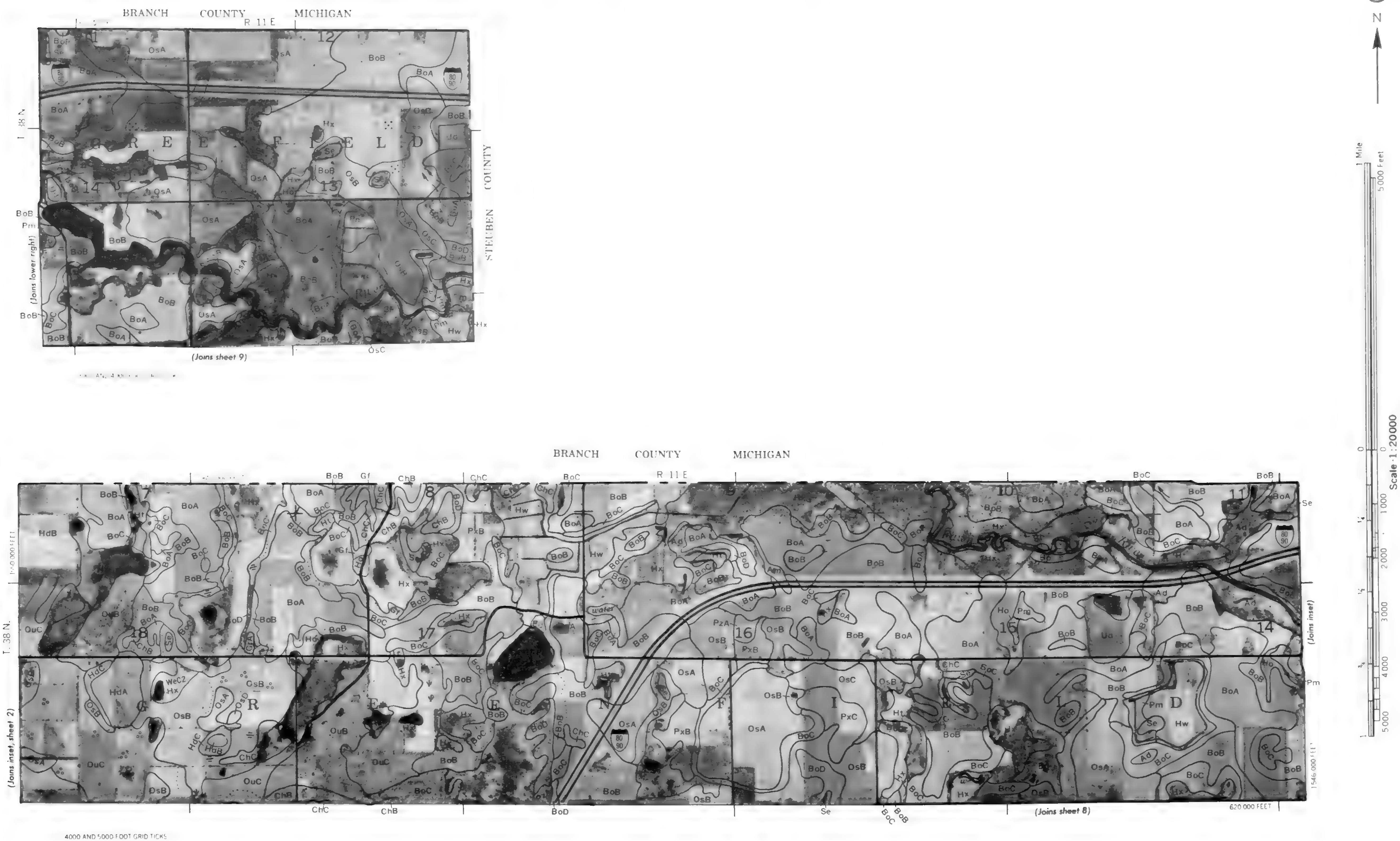
- Blowout
- Clay spot
- Gravelly spot
- Gumbo, slick or scabby spot (sodic)
- Dumps and other similar non soil areas
- Prominent hill or peak
- Rock outcrop (includes sandstone and shale)
- Saline spot
- Sandy spot
- Severely eroded spot
- Slide or slip (tips point upslope)
- Stony spot, very stony spot
- Muck spot
- Spot high in Iron

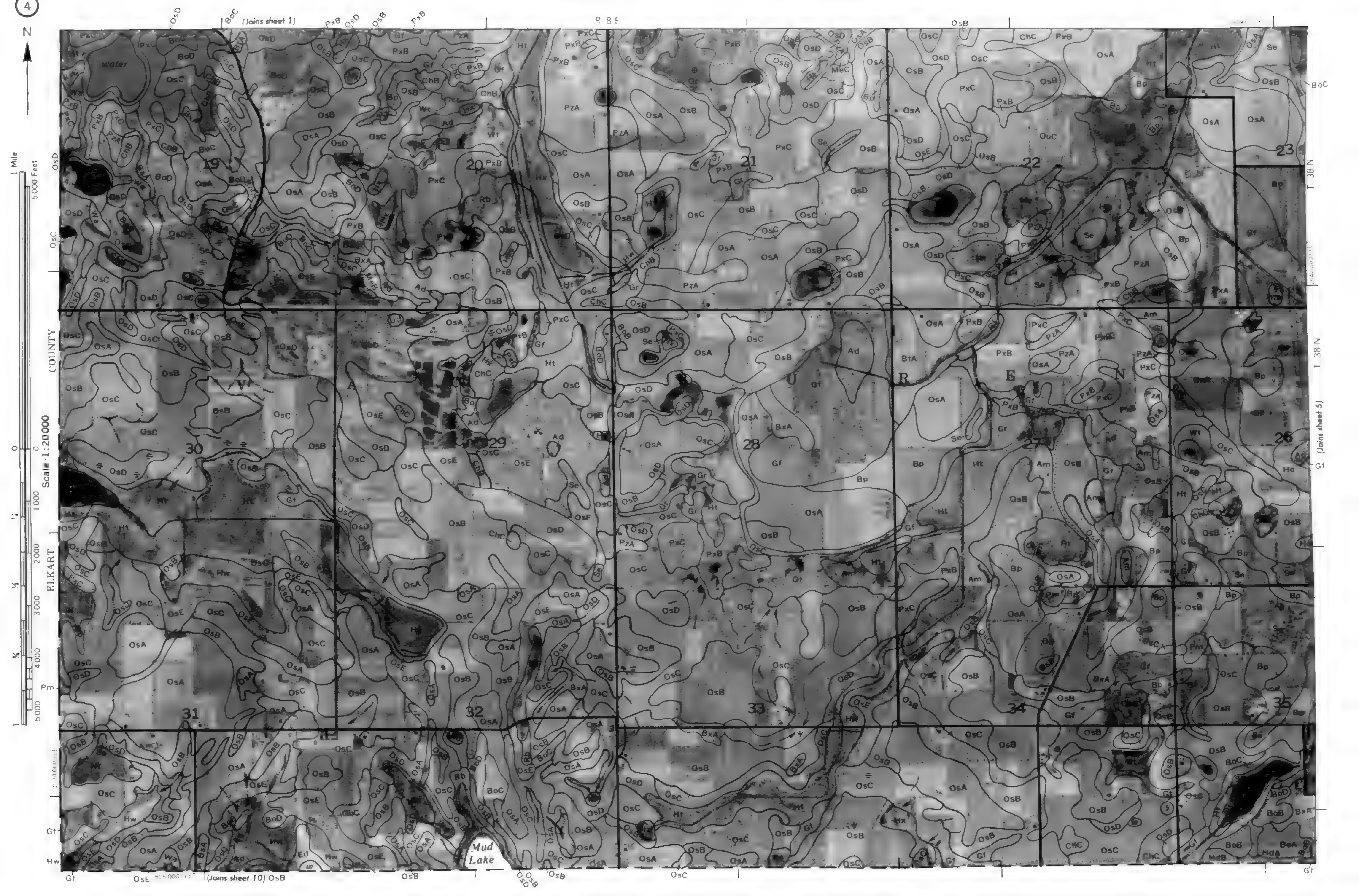
LAGRANGE COUNTY, INDIANA — SHEET NUMBER 1

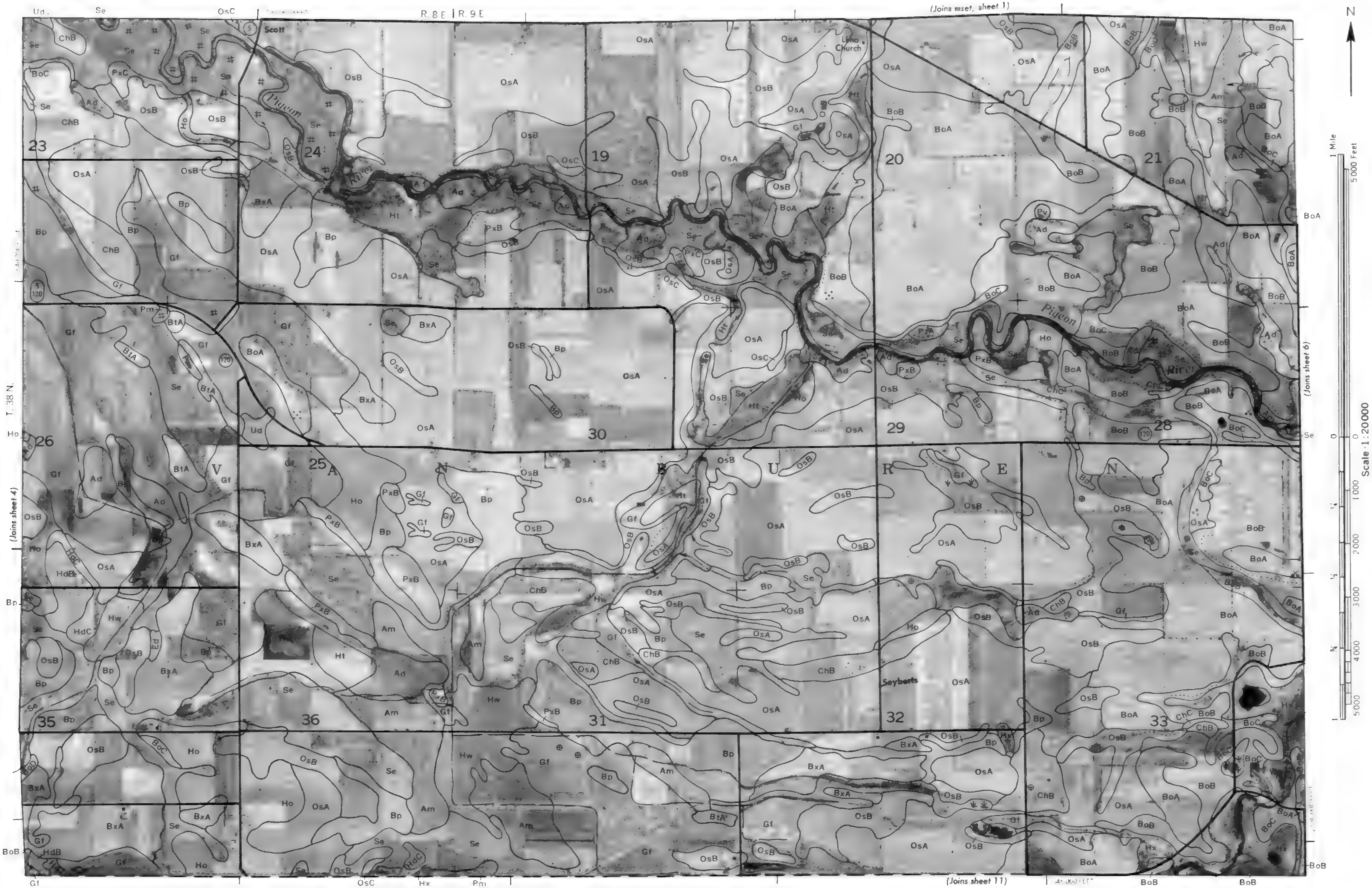



2
N
ST JOSEPH COUNTY MICHIGAN
R 10 E
(Joins lower right)
(Joins sheet 7)
(Joins sheet 3)
T. 38 N.
Pretty Prairie Church
BONTRAGER CEMETERY
L I M A
G R E E N F I E L D
1 Mile
5000 Feet
Scale 1:20000
ST JOSEPH COUNTY MICHIGAN
R. 9 E. | R. 10 E.
(Joins inset, sheet 1)
(Joins sheet 6)
(Joins inset)
I M A
T. 38 N.

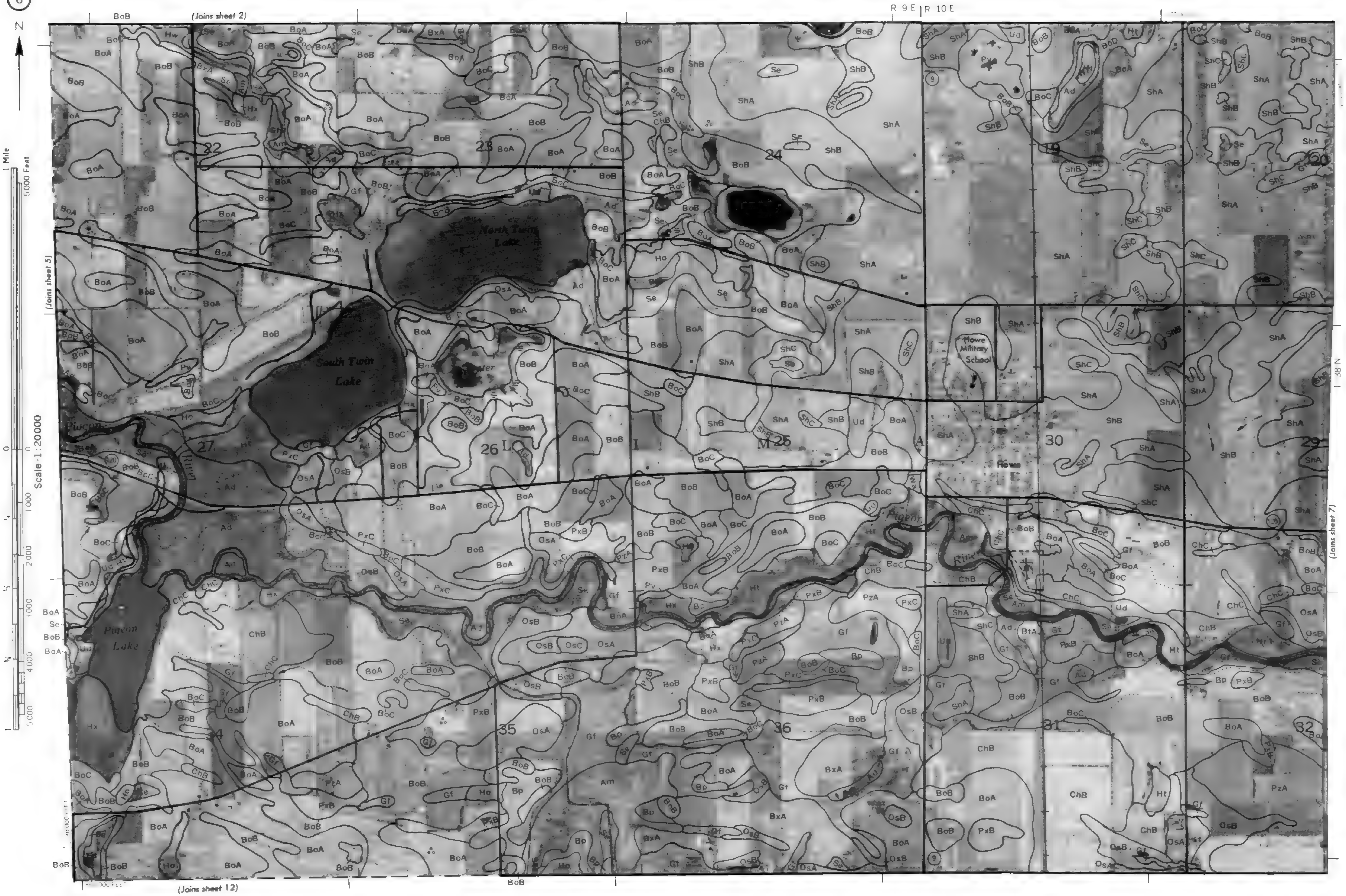
LAGRANGE COUNTY, INDIANA — SHEET NUMBER 3



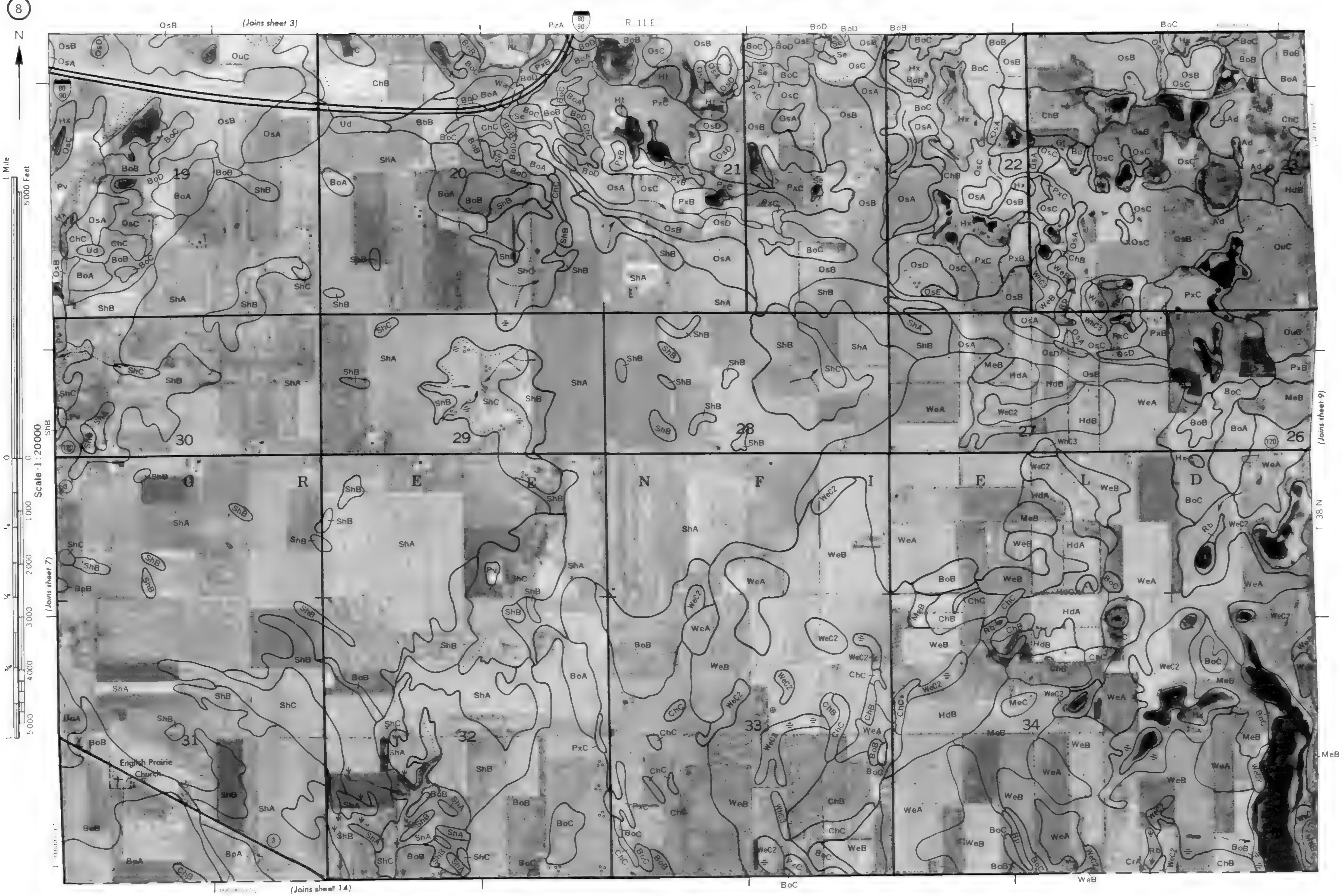

4
N
(Joins sheet 1)
R 8 E
T. 38 N
(Joins sheet 5)
(Joins sheet 10)
ELKHART COUNTY
Scale 1:20000
1 Mile
5000 Feet
Mud Lake
water

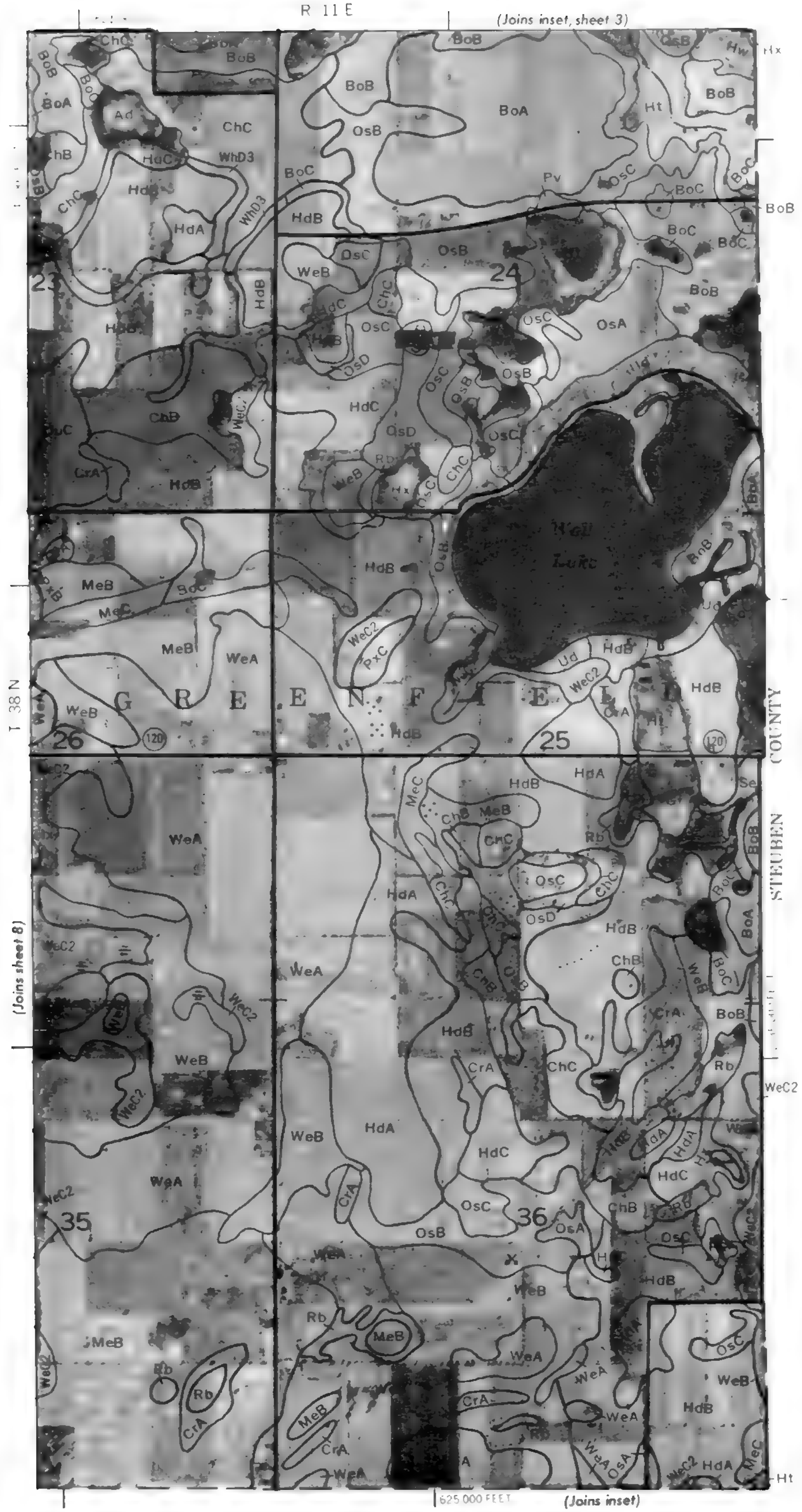


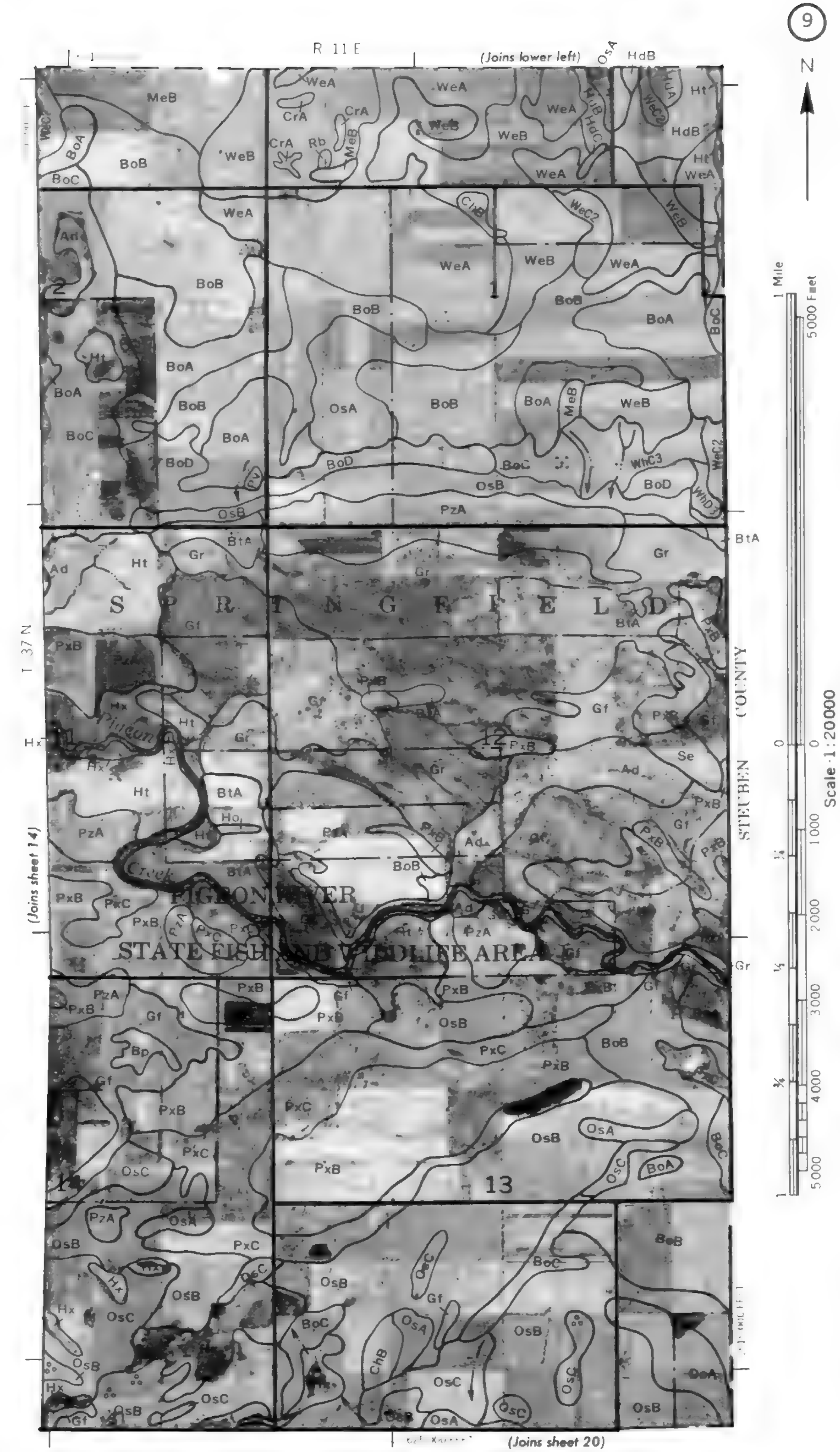
5
N
R.8 E. | R.9 E.
(Joins inset, sheet 1)
(Joins sheet 6)
(Joins sheet 11)
(Joins sheet 4)
T. 38 N.
Scott
Lima Church
Seyberts
Pigeon River
VAN BUREN
23
24
19
20
21
26
25
30
29
28
35
36
31
32
33
1 Mile
5000 Feet
Scale 1:20000
0
1000
2000
3000
4000
5000

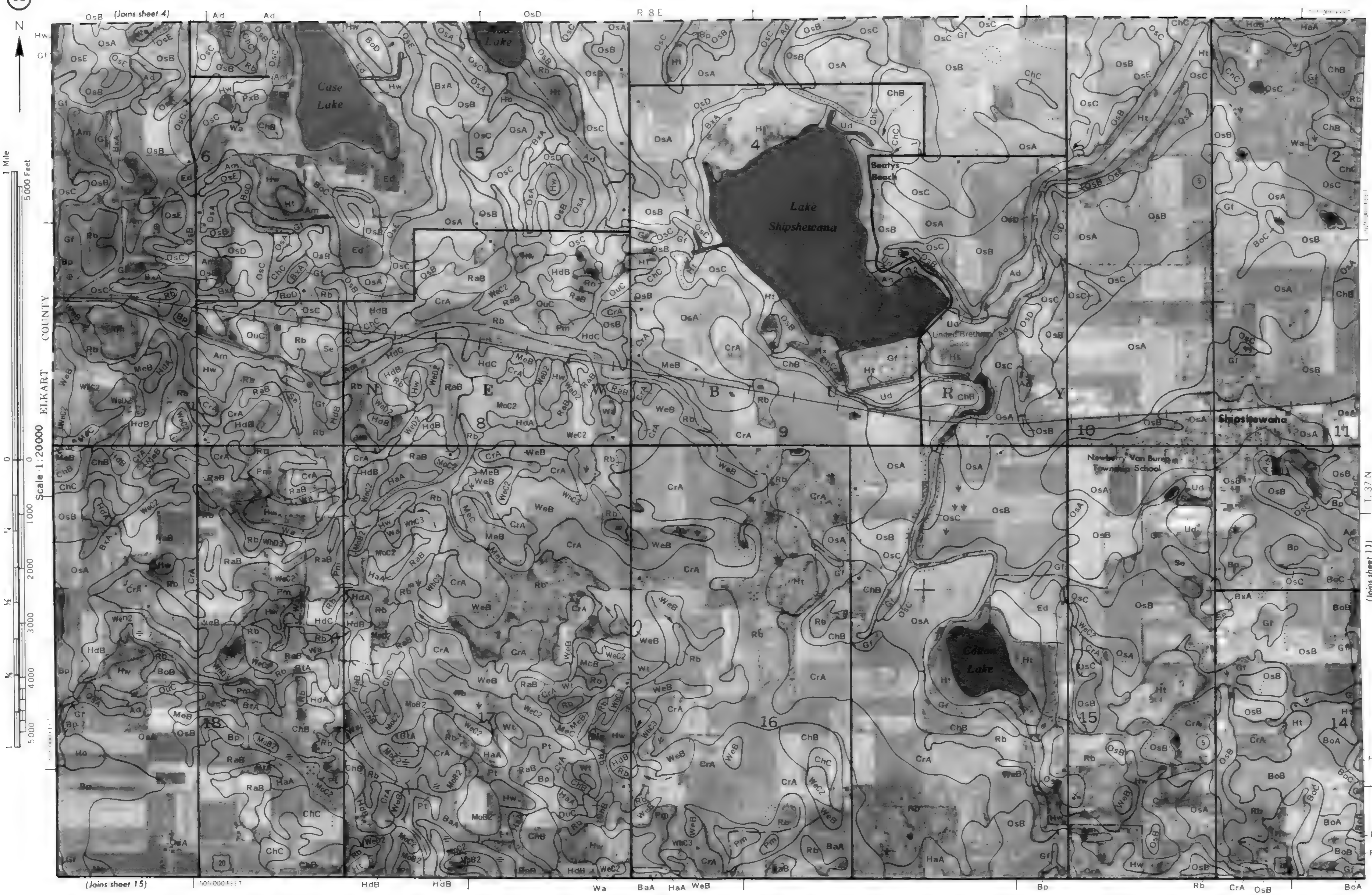

(Joins sheet 2)
(Joins sheet 5)
(Joins sheet 7)
(Joins sheet 12)
R 9 E | R 10 E
38 N
N
1 Mile
5000 Feet
Scale 1:20000
North Twin Lake
South Twin Lake
Pigeon Lake
Pigeon River
Howe Military School
Howe
22
23
24
19
20
27
26
25
30
29
34
35
36
31
32


7
N
R 10 E
T. 38 N
(Joins inset, sheet 2)
(Joins sheet 8)
(Joins sheet 13)
(Joins sheet 6)
Cedar Lake
Dallas Lake
G R E E N F I E L D
L I M A
PIGEON RIVER STATE FISH AND WILDLIFE AREA
Pigeon River
Ontario Millpond
Ontario
1 Mile
5000 Feet
Scale 1:20000
20
21
22
23
24
25
26
27
28
29
32
33
34
35
36


8
N
(Joins sheet 3)
R 11 E
(Joins sheet 7)
(Joins sheet 9)
(Joins sheet 14)
T 38 N
1 Mile
5000 Feet
Scale 1:20000
0
1000
2000
3000
4000
5000
G R E E N F I E L D
English Prairie Church
19
20
21
22
23
26
27
28
29
30
31
32
33
34


R 11 E
(Joins inset, sheet 3)
Wall Lake
G R E E N F I E L D
T 38 N
(Joins sheet 8)
STEUBEN COUNTY
23
24
26
25
35
36
625 000 FEET
(Joins inset)

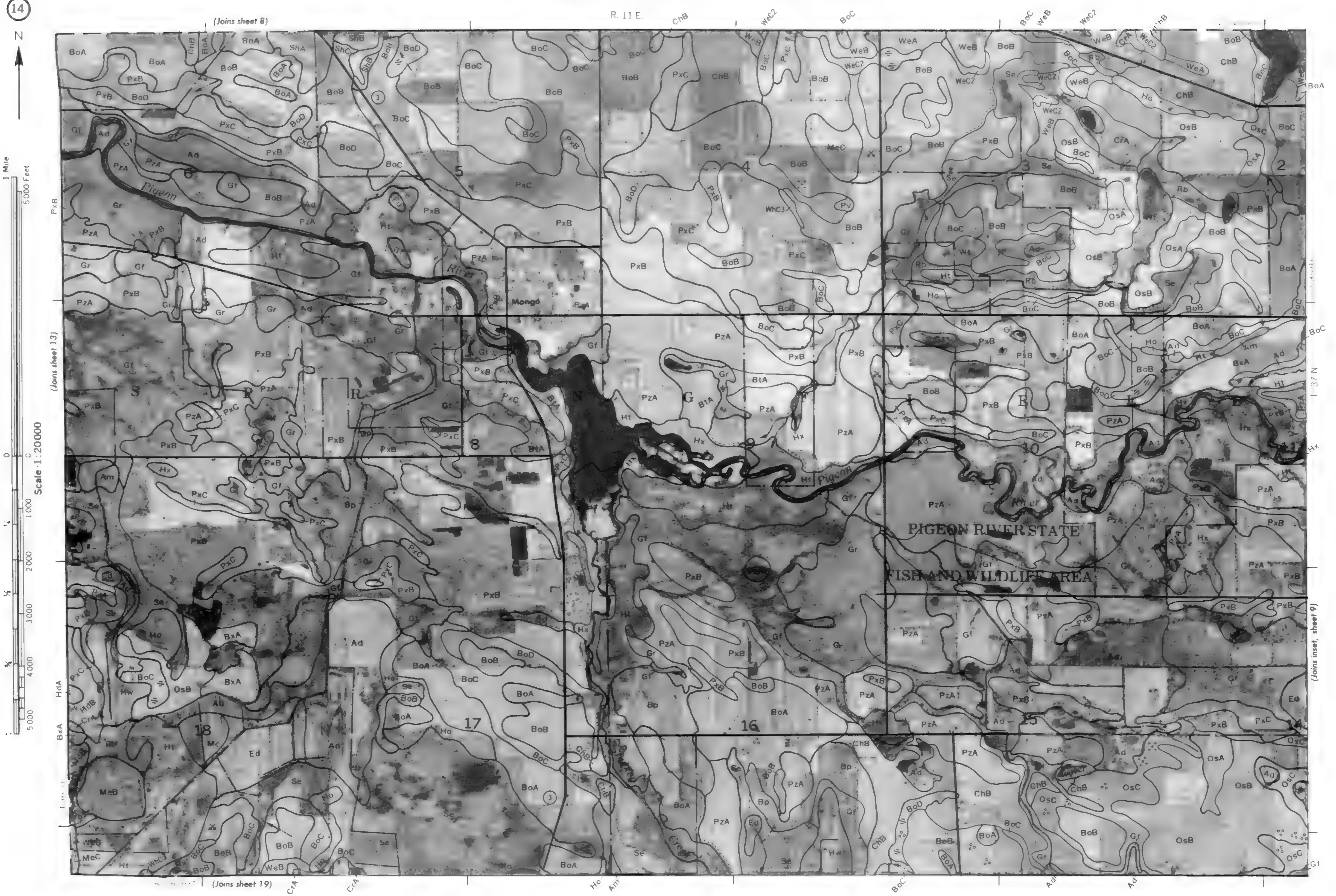

9
N
R 11 E
(Joins lower left)
S P R I N G F I E L D
T 37 N
(Joins sheet 14)
Pigeon Creek
PIGEON RIVER
STATE FISH AND WILDLIFE AREA
STEUBEN COUNTY
2
1
12
13
(Joins sheet 20)
1 Mile
5000 Feet
Scale 1:20000


(Joins sheet 4)
R 8 E
Case Lake
Lake Shipshewana
Beatys Beach
United Brethren Camp
Shipshewana
Newbury Van Buren Township School
Cotton Lake
N E W B U R Y
ELKART COUNTY
T. 37 N
(Joins sheet 11)
(Joins sheet 15)
505 000 FEET
Scale 1:20000
1 Mile
5000 Feet
N


R 8 E
R 9 E
(Joins sheet 5)
(Joins sheet 10)
(Joins sheet 12)
(Joins sheet 16)
T. 37 N.
N E W B U R Y
C L A Y
MILLER CEMETERY
Shore Church
Buck Creek
N
1 Mile
5000 Feet
Scale 1:20000

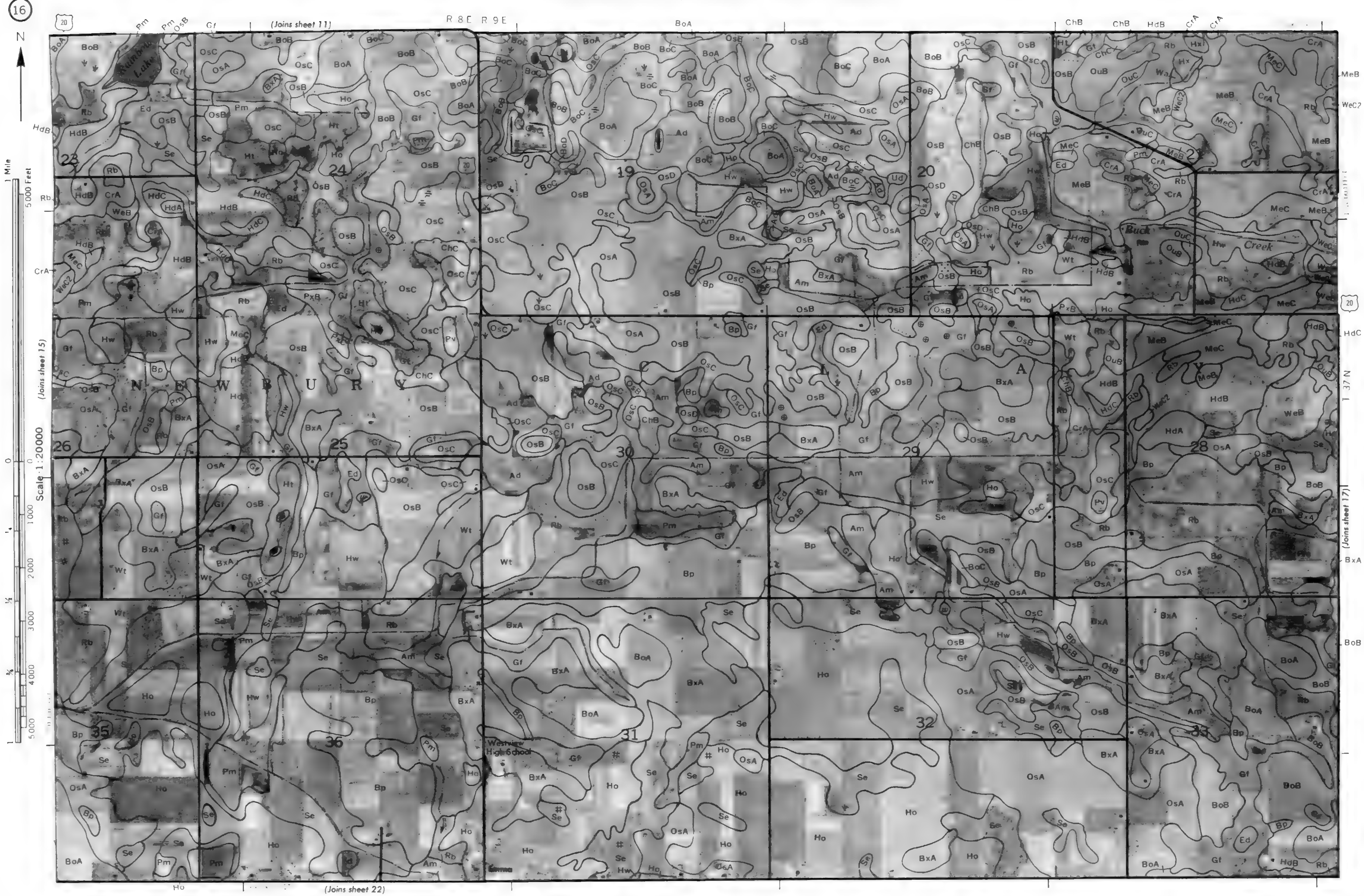

(Joins sheet 6)
R. 9 E.
R. 10 E.
N
1 Mile
5000 Feet
Scale 1:20000
(Joins sheet 11)
(Joins sheet 13)
(Joins sheet 17)
T. 37 N.
Buck
Creek
C L A Y
B L O O M F I E L D
BETHEL CEMETERY
1
2
3
5
6
7
8
10
11
12
13
14
15
17
18


13
N
(Joins sheet 7)
PIGEON RIVER STATE FISH
AND WILDLIFE AREA
Pigeon River
(Joins sheet 14)
(Joins sheet 12)
(Joins sheet 18)
R 10 E
T 37 N
Scale 1:20000
1 Mile
5000 Feet
0
1000
2000
3000
4000
5000
BLOOMFIELD


14
N
(Joins sheet 8)
R. 11 E.
(Joins sheet 13)
(Joins inset, sheet 9)
(Joins sheet 19)
T. 37 N.
1 Mile
5000 Feet
Scale 1:20000
Pigeon River
PIGEON RIVER STATE
FISH AND WILDLIFE AREA
Mongo
SPRINGFIELD


15
N
(Joins sheet 10)
(Joins sheet 16)
(Joins sheet 21)
R 8 E
ELKART COUNTY T 37 N
1 Mile
5000 Feet
Scale 1:20000
19
20
21
22
23
26
27
28
29
30
31
32
33
34
35
N E W B U R Y

LAGRANGE COUNTY, INDIANA — SHEET NUMBER 16

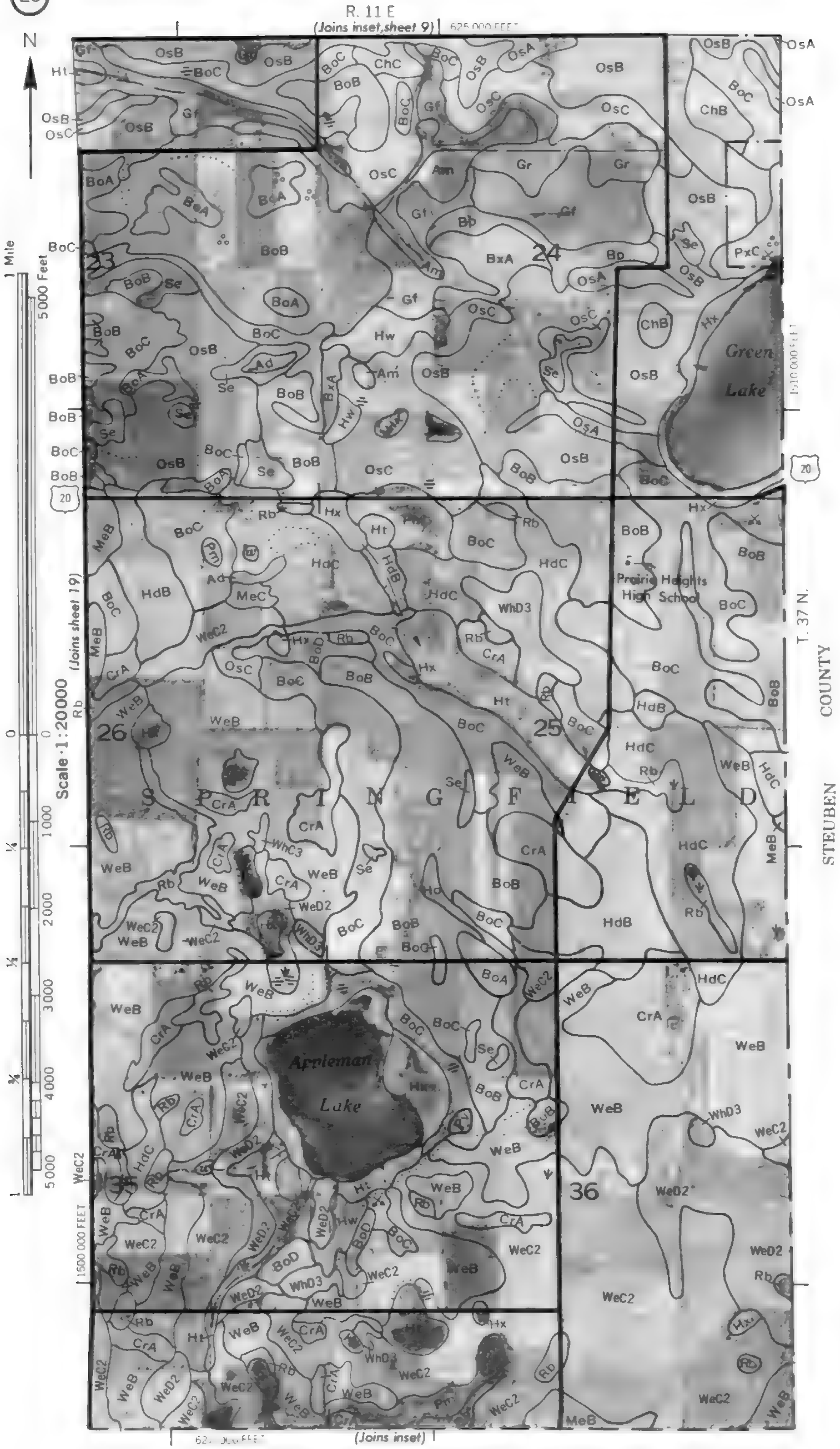


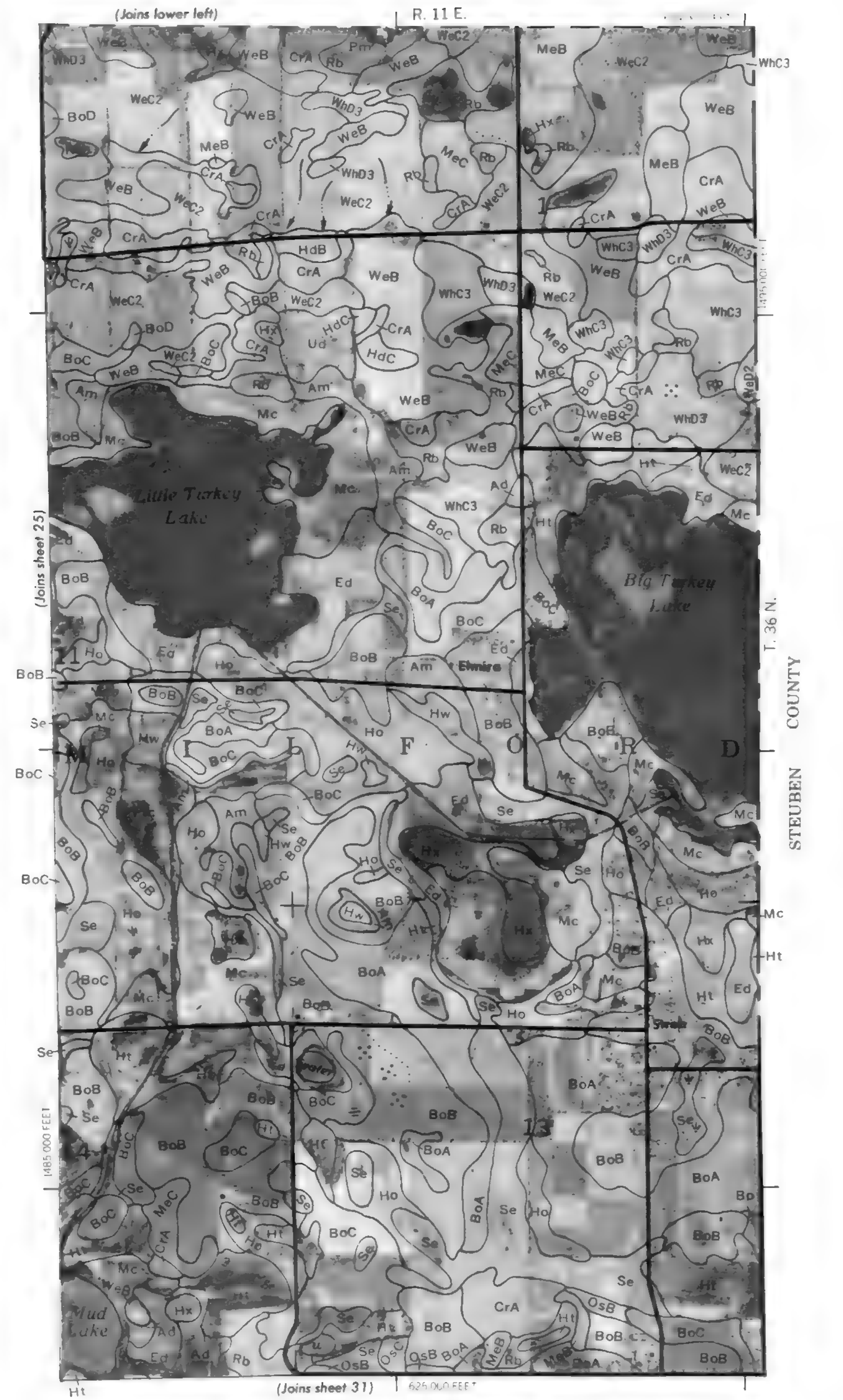

R. 9 E.
R. 10 E.
(Joins sheet 12)
(Joins sheet 16)
(Joins sheet 18)
(Joins sheet 23)
T. 37 N.
LA GRANGE
Lakeland High School
GREENWOOD CEMETERY
B L O O M F I E L D
Creek
N
1 Mile
5000 Feet
Scale 1:20000


18
N
(Joins sheet 13)
(Joins sheet 24)
(Joins sheet 17)
(Joins sheet 19)
R 10 E
T 37 N
Scale 1:20000
1 Mile
5000 Feet
Royer Lake
Lake
Creek
Plato


19
N
R 11 E
(Joins sheet 14)
(Joins sheet 18)
(Joins sheet 20)
(Joins sheet 25)
T 37 N
ROGERS CEMETERY
BRUSHY CHAPEL CEMETERY
Brushy Prairie
East Springfield Church
Turkey Creek
S P R I N G F I E L D
19
20
21
22
23
29
28
27
26
32
33
34
35
1 Mile
5000 Feet
Scale 1:20000

20


R. 11 E.
(Joins inset, sheet 9)
N
Green Lake
Prairie Heights High School
S P R I N G F I E L D
Appleman Lake
(Joins sheet 19)
T. 37 N.
STEUBEN COUNTY
1 Mile
5000 Feet
Scale 1:20000
(Joins inset)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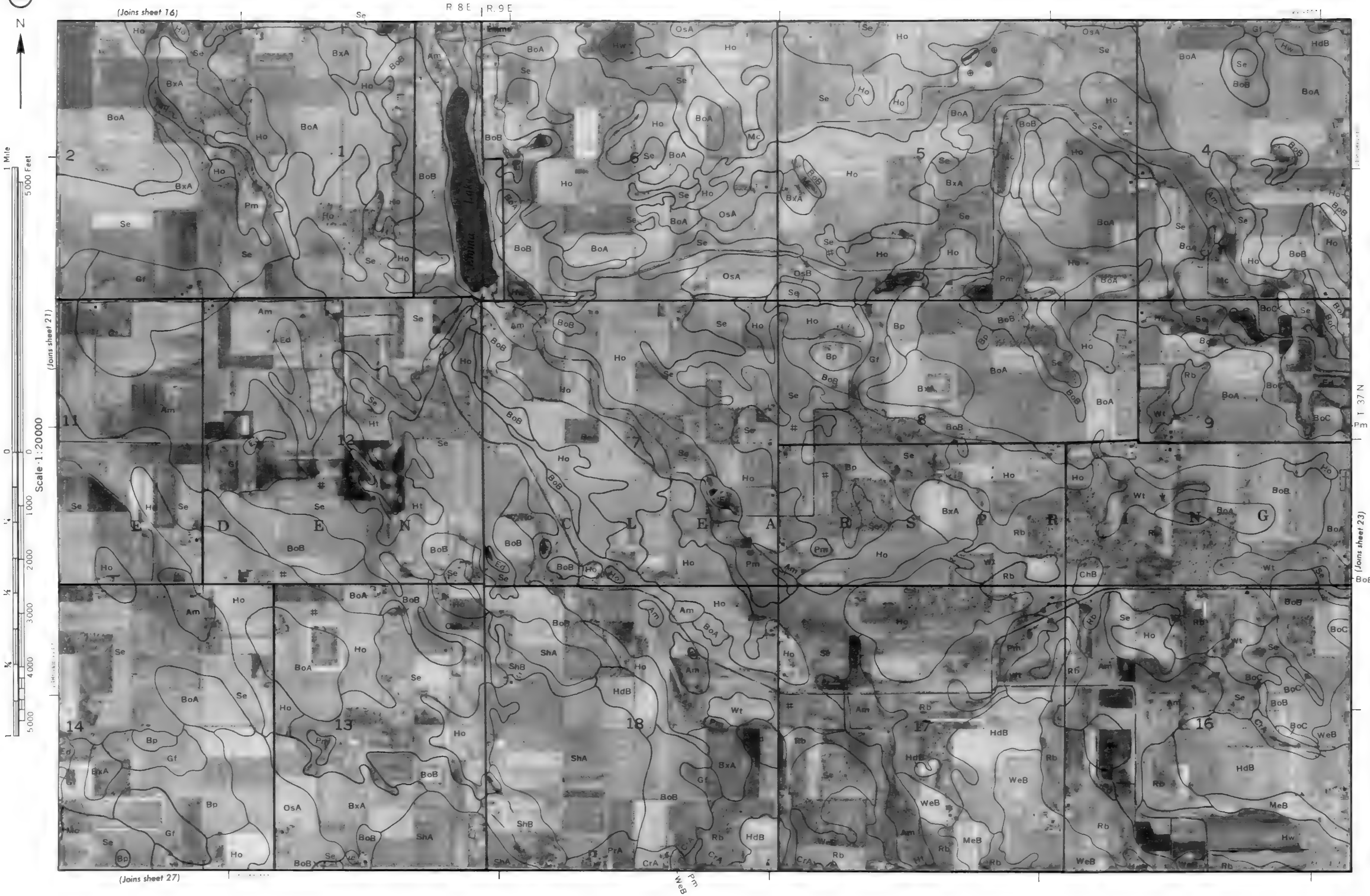
R. 11 E.
Little Turkey Lake
Big Turkey Lake
(Joins sheet 25)
M I L F O R D
Elmira
Mud Lake
T. 36 N.
STEUBEN COUNTY
(Joins sheet 31)

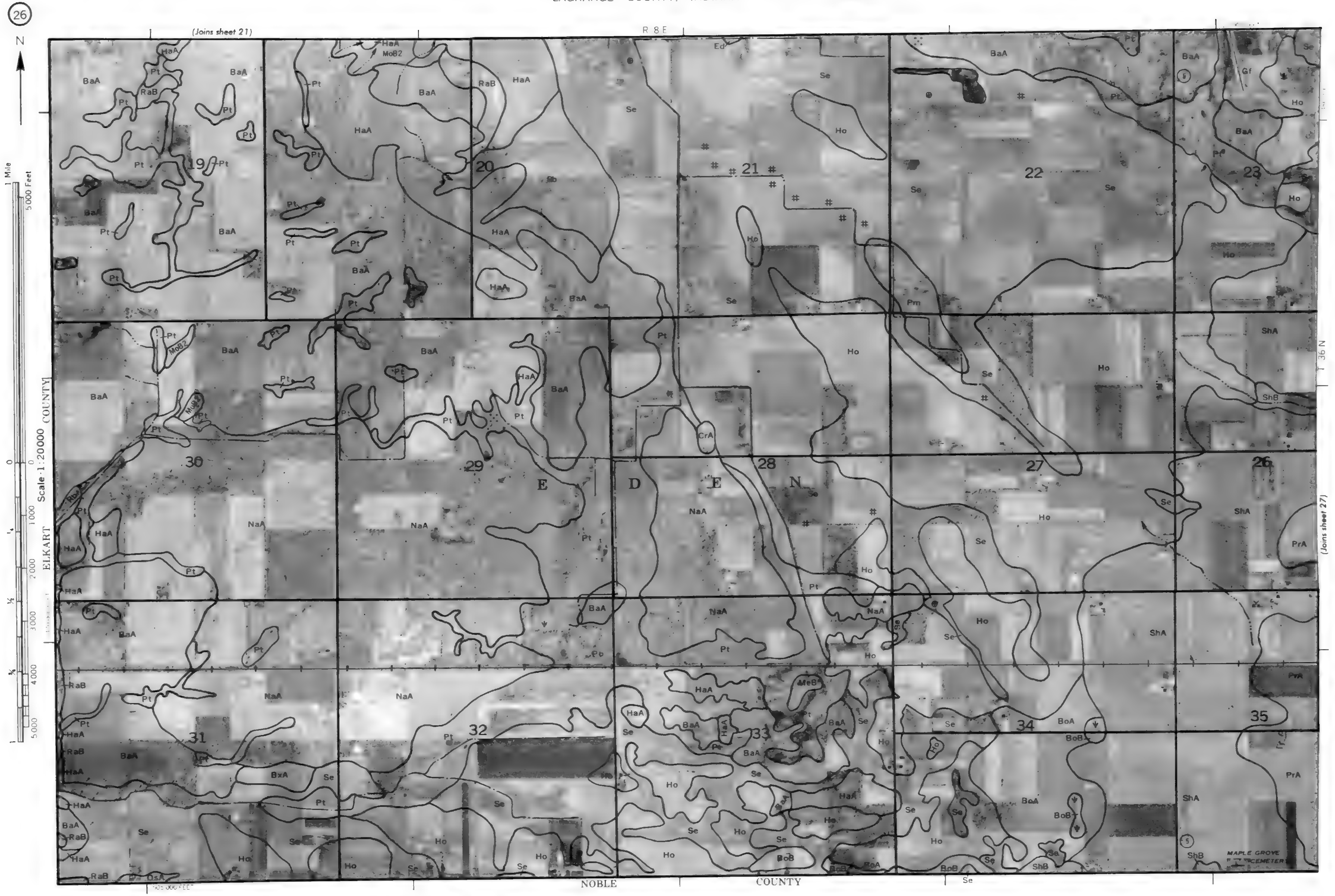

21
N
R 8 E
(Joins sheet 15)
(Joins sheet 22)
(Joins sheet 26)
ELKART COUNTY
T 37 N
Scale 1:20000
1 Mile
5000 Feet
TOWN LINE CEMETERY
Honeyville
575 000 FEET
1485 000 FEET


(Joins sheet 16)
R 8 E
R. 9 E
N
1 Mile
5000 Feet
Scale 1:20000
(Joins sheet 21)
(Joins sheet 23)
(Joins sheet 27)
T. 37 N.
Lake
E D E N
C L E A R S P R I N G


23
N
(Joins sheet 17)
(Joins sheet 22)
(Joins sheet 24)
(Joins sheet 28)
R 9 E | R 10 E
T. 36 N.
Buck Creek
Buck Creek
OSBORN CEMETERY
JORDAN CEMETERY
C L E A R S P R I N G
J O H N S O N
Oliver Lake
Quag Lake
Grass Pond
Scale 1:20000
1 Mile
5000 Feet


24
N
(Joins sheet 18)
(Joins sheet 23)
(Joins sheet 25)
(Joins sheet 29)
R 10 E
T 36 N
1 Mile
5000 Feet
Scale 1:20000
Royer Lake
Fly Creek
Valentine
Woodruff
Creek


(Joins sheet 19)
(Joins sheet 24)
(Joins inset sheet 20)
(Joins sheet 30)
R 11 E
T 36 N
N
Pretty Lake
Turkey
1 Mile
5000 Feet
Scale 1:20000


26
N
(Joins sheet 21)
R 8 E
T 36 N
(Joins sheet 27)
ELKART COUNTY
NOBLE COUNTY
EDEN
Scale 1:20000
1 Mile
5000 Feet
MAPLE GROVE CEMETERY


R 8 E | R 9 E
(Joins sheet 22)
(Joins sheet 28)
(Joins sheet 26)
T 36 N
N
1 Mile
5000 Feet
Scale 1:20000
0
1000
2000
3000
4000
5000
Topeka
Beulah Church
NOBLE COUNTY
19
20
21
23
24
25
26
28
29
30
31
32
33
35
36
E
D
E
N
C
L
E
A
R
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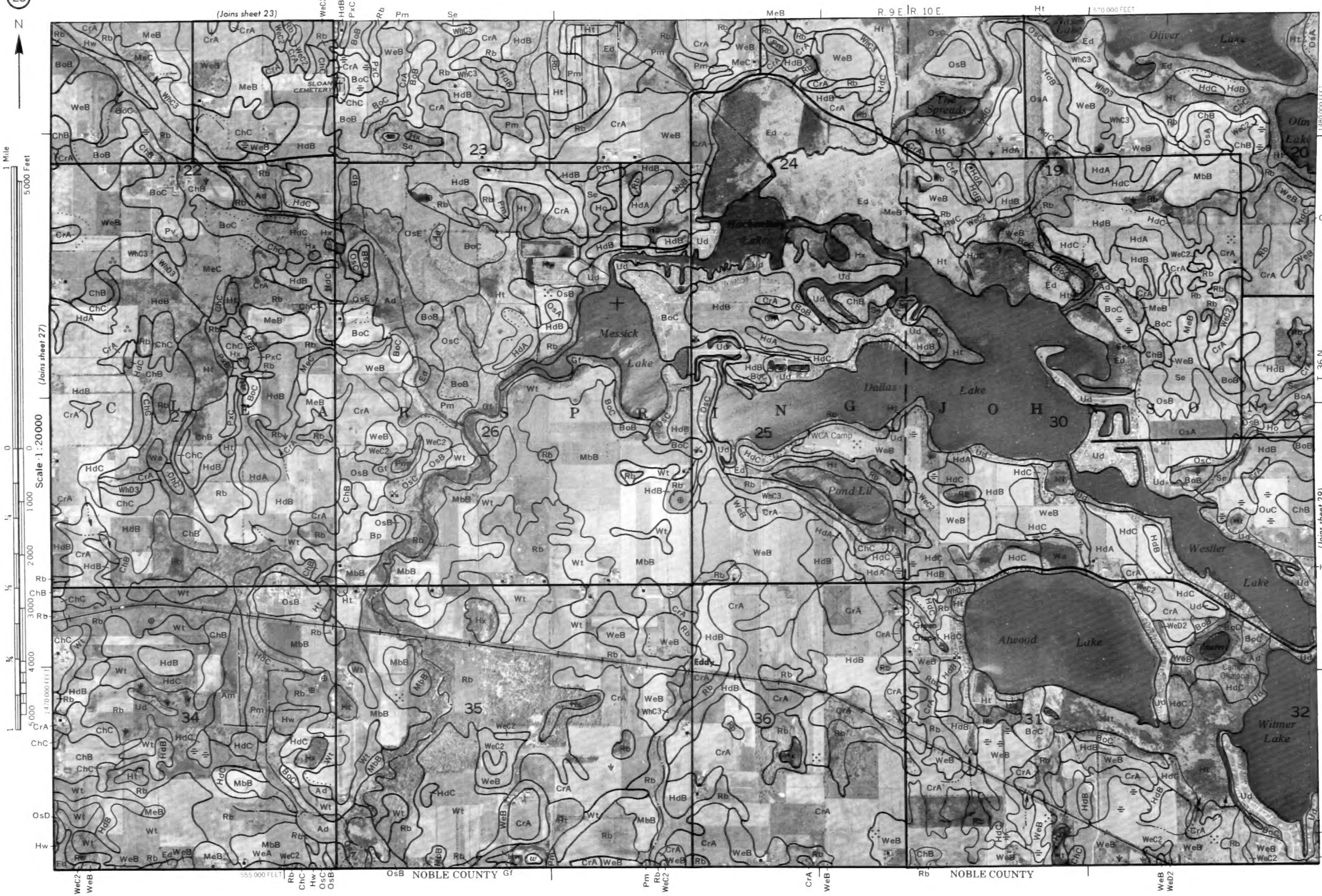
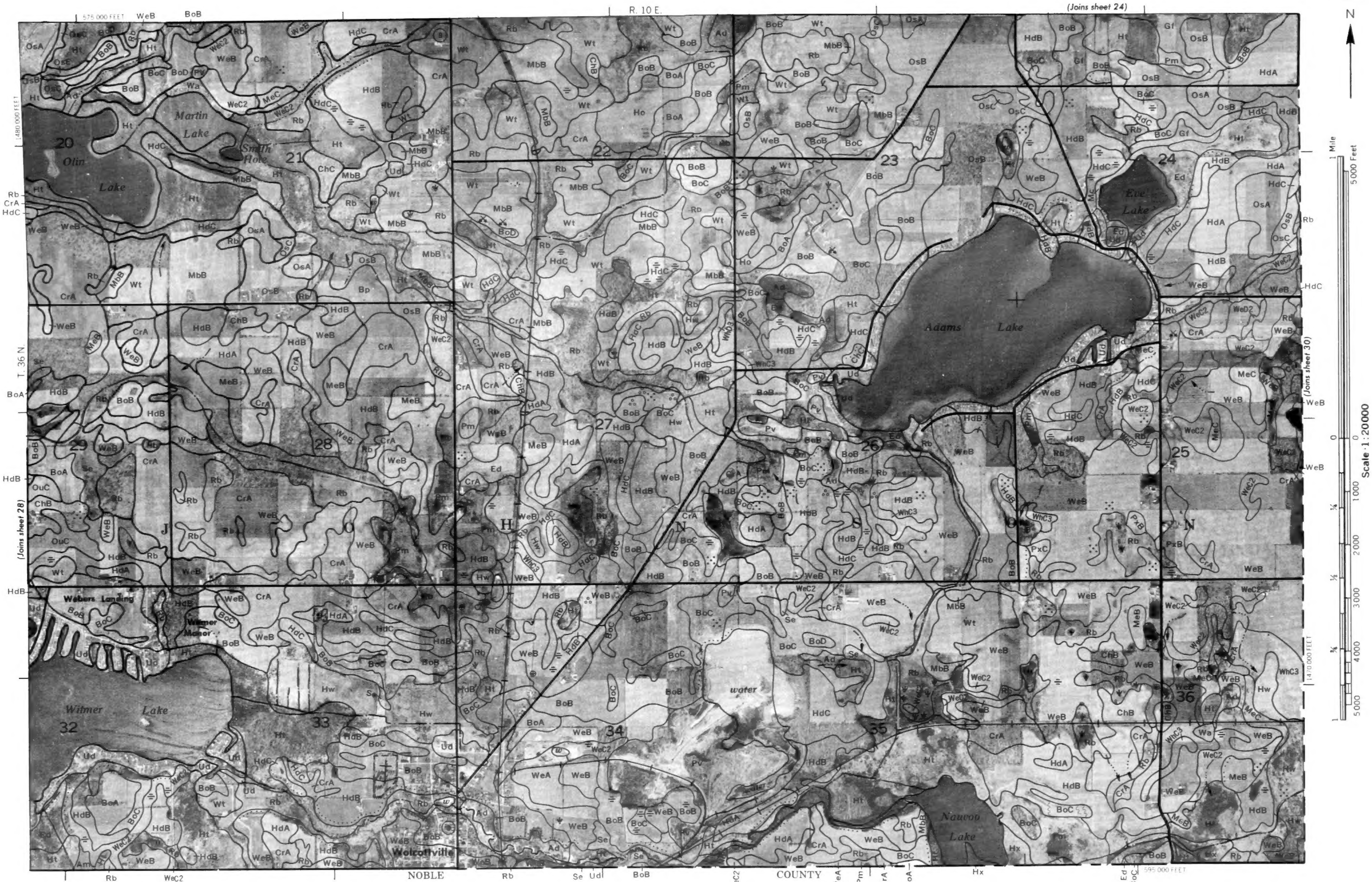
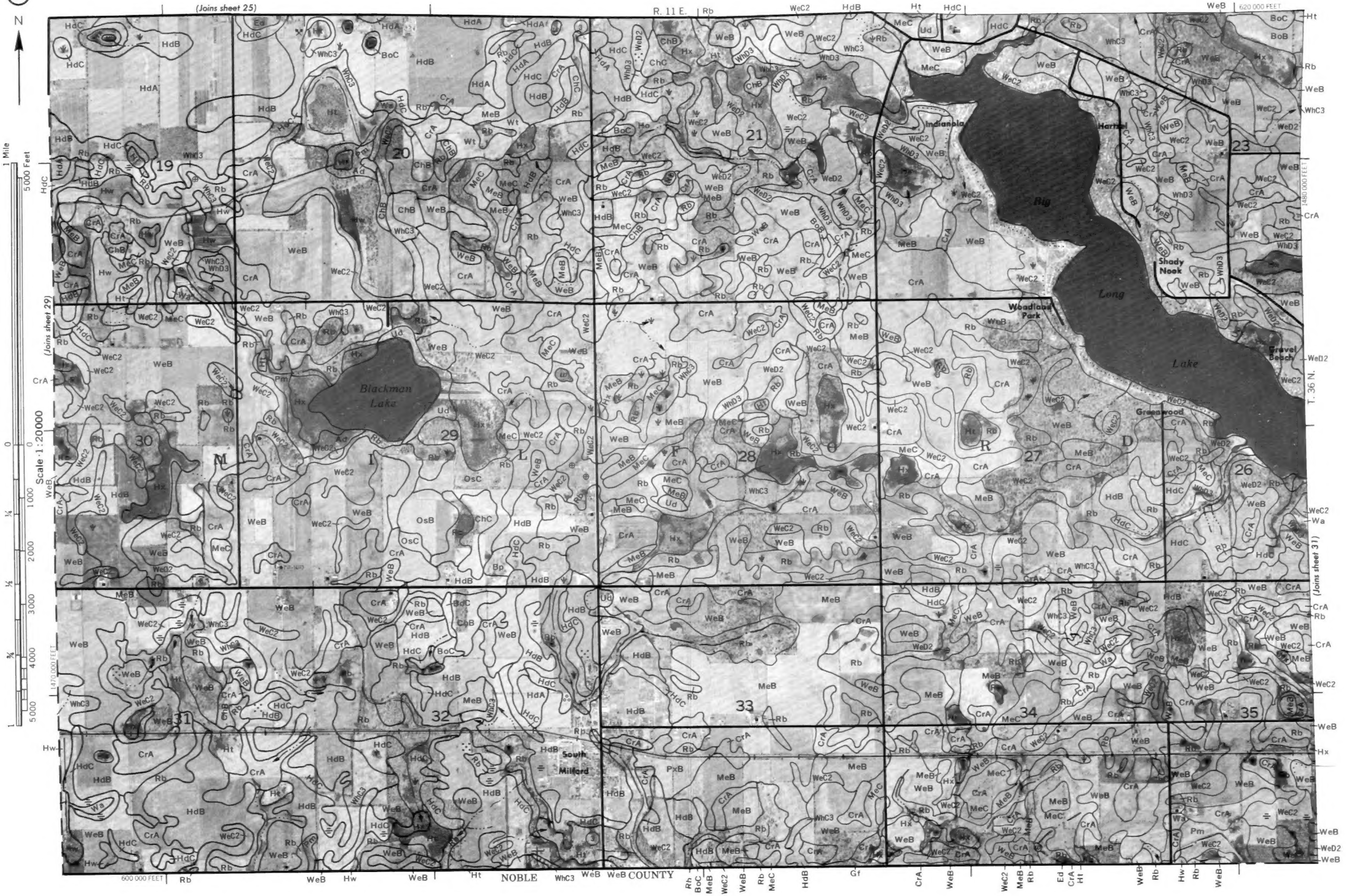
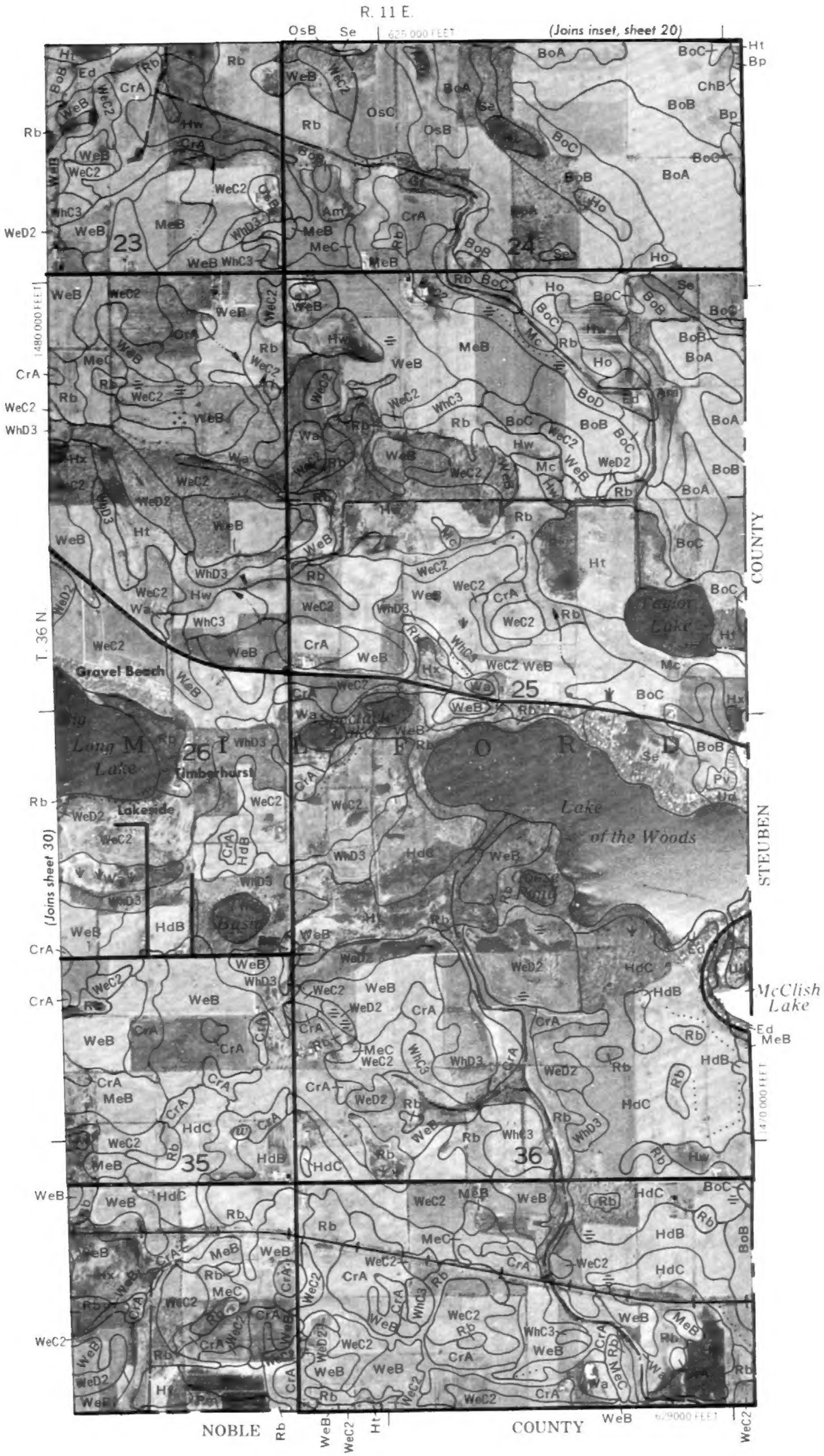
P
R
I
N
G


(Joins sheet 23)
(Joins sheet 27)
(Joins sheet 29)
N
1 Mile
5000 Feet
Scale 1:20000
R. 9 E. R. 10 E.
T. 36 N.
570 000 FEET
1 480 000 FEET
470 000 FEET
555 000 FEET
SLOAN CEMETERY
Oliver Lake
The Spreads
Olin Lake
Messick Lake
Dallas Lake
Pond Lil
WCA Camp
Westler Lake
Atwood Lake
Witmer Lake
Green Chapel
Camp Okatona
Eddy
C L E A R S P R I N G
J O H N S O N
22
23
24
19
20
26
25
30
27
29
34
35
36
31
32
NOBLE COUNTY
NOBLE COUNTY


29
N
(Joins sheet 24)
(Joins sheet 28)
(Joins sheet 30)
R. 10 E.
T. 36 N.
575 000 FEET
480 000 FEET
595 000 FEET
1470 000 FEET
Martin Lake
Smith Hole
Olin Lake
Eve Lake
Adams Lake
Webers Landing
Witmer Manor
Witmer Lake
water
Nauvoo Lake
Wolcottville
NOBLE
COUNTY
20
21
22
23
24
25
26
27
28
29
32
33
34
35
36
Scale 1:20000
1 Mile
5000 Feet
0
1000
2000
3000
4000
5000

30


(Joins sheet 25)
(Joins sheet 29)
(Joins sheet 31)
R. 11 E.
T. 36 N.
N
Scale 1:20000
1 Mile
5000 Feet
620 000 FEET
1480 000 FEET
1470 000 FEET
600 000 FEET
Blackman Lake
Big Long Lake
Indianola
Hartzel
Shady Nook
Woodland Park
Gravel Beach
Greenwood
South Milford
NOBLE COUNTY



4000 AND 5000 FOOT GRID TICKS